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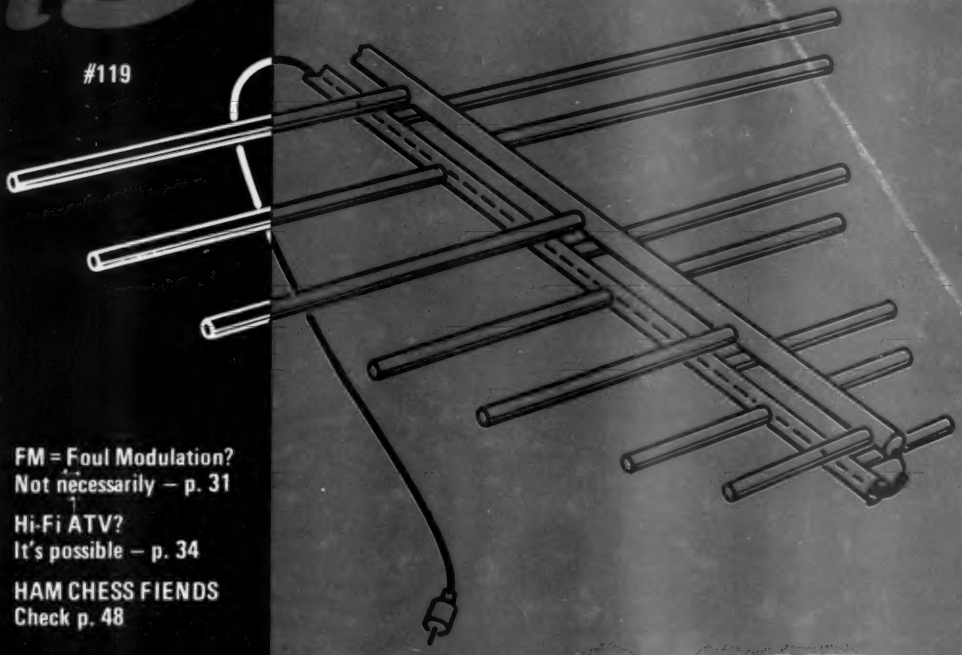

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It's possible – p. 34

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2M Xstr Xmtr?
Yup – p. 54

$2.85 VHF Wattmeter?
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73 MAGAZINE

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STAFF

Editor-Publisher
Wayne Green W2NSD/1

Managing Editor
Ken Sessions K6MVH/1

Associate Editor
Jim Kyle K5JKX

Advertising
Diane Shaw
Dan Shepard

Art Director
Roger Block

Graphic Arts
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Nancy Estle

Composition
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Drafting
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Subscriptions
Dorothy Gibson

Circulation
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Comptroller
Bing Hawes

Traffic
Jeff Parsons

Propagation
John Nelson

WTW Editor
Dave Mann K2AGZ

FCC Liaison
Bob Nelson WA5MAM/4

73 Magazine is published monthly by 73, Inc., Pine St., Peterborough, New Hampshire 03458. Subscription rate: $12.00 for three years, $6.00 for one year. Second Class Postage paid at Peterborough, New Hampshire, and at additional mailing offices. Printed at Menasha, Wisconsin 54952, U.S.A. *Entire contents copyright 1970 by 73, Inc., Peterborough, New Hampshire 03458.*

Amateur Radio News Page

HAM'S QSO SAVES LIFE IN COSTA RICA

Radio-TV Men Watch as 'Mercy Mission' Drama Unfolds

Thanks to the efforts of a few conscientious hams, an alert newspaper, and a mercy-minded airline, a Costa Rican hemophiliac was saved from what doctors said was "sure death." The incident was a highly dramatic example of the importance of ham radio to a community.

The international "mercy mission" was touched off by Long Beach, California Amateur Nate Brightman K6OSC, who received an urgent message from a Tuna clipper fishing off the coast of Mexico. The vessel's radio operator, Rodriguez Beeche TI8RBL, was relaying a message from Dr. Herman Weinstock in San Jose, Costa Rica, asking Brightman to arrange an immediate shipment of Hemophil, a blot-clotting agent produced by Hyland Labs, a Glendale, California firm.

Dr. Weinstock related, via ham radio, that his patient, 24-year-old Eduardo Castro, required an immediate

A helicopter furnished by the L. A. Sheriff stood ready in Glendale to pick up a vital serum and rush it to a waiting Pan-Am jet at the L. A. International Airport.

arrived at the airport with the drug, about a half-hour after the Pan-Am jet's scheduled takeoff.

The Hemophil was delivered on time, and the patient responded so well to the medication that an operation was found unnecessary.

dent from the outset. Dr. Weinstock's messages were phone-patched out by his ham brother, Salomen Weinstock TIZWC. Louis D. Arce TI2LA provided postdelivery information from San Jose for Stateside newsmen. Pablo Fonseca TI4PL and Gene

CITIZENS PROTEST HAM RADIO TOWER

While a ham in Long Beach worked to save the life of a dying man in another part of the world (see headline, this issue), another amateur in a neighboring community was being legally "assailed" by public-spirited citizens who were protesting installation of a 55 ft tower.

Tom Rothwell, an Extra class ham of Los Alamitos, California, had applied for and received permission to construct the tower, but residents in the area appealed the decision. The city council called a public hearing after reading a petition signed by 63 townspeople.

In defense, the amateur radio operator stressed the importance of ham radio during natural and man-made disasters when other means of communication are disabled. He asserted, logically, that his installation could prove vital to the community.

After listening to protests from most of the 45 people present at the hearing, City Attorney Jack Parker ordered a continuance so the council

uardo Castro, required an immediate operation for bleeding ulcers and would have "no chance for survival" without the coagulant.

In contacting Hyland Labs by telephone, Brightman learned that the firm's supply of the drug had been depleted, and that the earliest time a new batch would be ready was the following morning – but not quite in time to catch the only available plane for Costa Rica.

Recognizing that a certain amount of pressure would be required to coordinate the various elements of the situation, Brightman called the local newspaper, the Long Beach Independent Press Telegram, and asked help in getting the drug to its destination.

With the news media tuned in, the ball started rolling, as TV channel 9, radio station KFWB, and the Press-Telegram provided heavy publicity. The newspaper called Pan-Am World Airways' New York office and obtained the authorization necessary to hold the Costa Rican flight long enough to get the drug aboard. Then it arranged for a Los Angeles Sheriff's helicopter to fly the drug the 20 miles from the lab to the airport as soon as it was produced.

Newsmen and TV cameramen were standing by when the helicopter was found unnecessary.

A *73* reporter talked to Nate Brightman and learned that several amateurs had been involved in the incident. Fonseca TI4PF and George (TI2IT) also provided message handling and phone-patch services during the overnight intercontinental emergency.

Food for Thought: Without a similar facility, Long Beach operator Nate Brightman might not have been in a position to put into motion the chain of events that saved a life. If Brightman's neighbors had been as short-sighted as Rothwell's, what would have happened to the hemophilia victim in Costa Rica?

DARC President Visits U.S.

Karl Schultheiss, the president of the DARC, will be visiting the U.S. in late August and early September, staying with WA2ELA in Dewitt, New York and traveling from there. Perhaps your club could arrange for Karl to visit? Write to James Kirkgasser, 105 Haddonfield Place, Dewitt, N.Y. 13214 and make arrangements.

Polish Ham's Death Felt Worldwide

by W4WFL

Amateur radio lost another pioneer with the recent passing of Jan Ziembicki (SP6FZ).

Active as early as 1921 with the callsign TPAR, Jan's interests embraced all aspects of amateur radio. He was one of the earliest experimenters on the VHF and UHF frequencies and by the mid-thirties was experimenting with television transmission.

Following the allocation of international prefixes, Jan operated under the callsigns SP5AR and SP1AR until the outbreak of World War II. After the war he was unable to obtain a license until the mid-fifties when he returned to the air as SP6FZ.

Jan quickly established himself as a leading DX'er, garnering most of the important awards, including DXCC and WAZ.

His rig was completely homebrew and constructed from a wide variety of surplus, commercial, and homemade parts. It covered the bands from 80 meters through 450 MHz, phone and CW.

Jan was a doctor of engineering and in recent years he was associated with the University of Warclow where he was involved in the design and application of electrical and electronic devices for use in cardiology and other areas of medicine.

His passing is a heavy loss to family and friends and to amateur radio.

Scholarship Set for Student Hams

The Foundation for Amateur Radio, Inc., a nonprofit organization headquartered in Washington, D.C., announces its intent to make the annual award of the John Gore Memorial Scholarship for either graduate or undergraduate study. The Scholarship pays $500 for the academic year. Upon reapplication, it is subject to being renewed for succeeding years.

Licensed radio amateurs who intend making a career in electronics or related sciences may now request the application for covering the academic year 1970–1971. Requests should be addressed to Chairman, Scholarship Committee, 8101 Hampden Lane, Bethesda, Maryland 20014. The award will be made during the month of December 1970. Receipt of applications for the award must be received by the close of business on 31 October 1970.

To be eligible for the award, applicants must have completed at least one year in an accredited college or university and must be enrolled in a course of studies leading to a degree. They must also be radio amateurs holding a valid FCC license of at least a General level.

MARS OPS GET SSTV DEMO

The enlisted men's service club at Andrews AFB was the scene of a slowscan TV demonstration in which 18 Air Force MARS operators were in attendance. Dr. Theodore J. Cohen (W4UMF) reviewed the broad field of slow-scan communications, beginning with a discussion of bandwidth–time considerations, and continuing on through equipment construction, color transmission, and computer processing of slow-scan pictures. A live demonstration of a slow-scan monitor, using taped pictures as a source, topped off the evening. Among those in attendance was the recently appointed Chief of Air Force MARS, Capt. Jan P. Huggins (WB4ONK). Col. Paul Ridenour (W8KDS) hosted the meeting.

Dr. Theodore J. Cohen, W4UMF, addressing Andrews AFB Radio Club.

DX NEWS

by W2NSD/1

GUS SWAMPED. . .ALMOST!

After three days of operation on Geyser Reef as ACØA/GR, the high winds and heavy rain took their toll. When two drums of gasoline floated away Gus had to give up temporarily and make the hard trip back to the Comoro Islands for more gas. The reef is very difficult to get on and there is only a very small place for a station to be set up. . .and even that gets splashed by the larger breakers. The propagation conditions, as accurately forecast in *73*, were dismal on 15 and 10 meters

Trevor 5W1AR has been active from Western Samoa, bless him. He is living in the same house as 5W1AZ and, I believe, using the same rig. This is the rig I used when I visited there back in 1966 and racked up a couple thousand contacts almost overnight. Trevor was my first contact with 5W1. . .the problem was that the previous op had a small circle of friends that he worked, and that was about it.

Market Reef has been busy again. . .third time since it passed muster as a country. This time ops are OH2BH (Martin) and about ten

More activity from Qatar (pronounced gutter) as Tom MP4BHH brings a rig down to Dave MP4QBK and leaves it with him in late June. AP2KS is weak, but in there on 20.

5T2ITU was doing well during a May contest, though Mauritania is not extremely rare these days, what with 5T5ADand lists by PY2PE. Even old familiar calls like KM6 seem rare these days. KM6BI (Glen) called in the other day to say hello, my first KM6 is ages. KW6EJ (Jack) has moved down to the Caroline Islands now and can be heard reguaarly as KC6EJ. Those strange calls that turn up during contests make the ITU prefix list handy (73,July 1970).

ZZ2ERS (PY) says QSL to WB9BWU. ZV7APS did well in the contest and is also from Brazil.

Around The Amateur World

Excerpts from IARU Region I News

CZECHOSLOVAKIA. Czechoslovakia has nearly 3000 amateur radio stations of which about 500 are club stations with registered operators and shortwave listeners. Besides the activity on HF and VHF bands there is amateur radio activity in connection with fox hunting, high-speed code contacts and the construction of elcctronic equipment. The *Central Radio Club of the Czechoslovak Socialist Republic* has an office in Prague which carries out the work of the QSL Bureau, certificates and awards and contest organization. The Novice license allows operation on the 1.8 and 145 MHz bands with a maximum input of 10W. The full license has three classes: Class C, 25W input on restricted bands; Class B, 75W input on all bands and all types of emission, and Class A, 300W input on all bands using all types of emission. The first Czech DX club was recently formed by a group of amateurs from Slovakia. Dr. Harry Cincura OK3EA was elected club president and OK3IR became secretary. OK3-DX club has 28 full members and 37 others, to promote interest, a weekly DX bulletin (DX-NT) has been established. The editor of DX-NT is Joko Straka OK3UL. Dr. Cincura was a member of the Czechoslovak delegation to the 1969 Region I Conference at Brussels. This news of the formation of OK3-DX was sent by Tibor Polak OK3BG.

EAST AFRICA. Please note that the address of the RSEA QSL bureau is Box 5681, Nairobi, Kenya. In addition to exhibiting at Electra 70 the RSEA will again be providing communication facilities for the East African Safari.

GERMANY. During 1969, 179 reciprocal licenses for operation in Germany were issued by the DARC office of International Affairs. All

by the larger breakers. The propagation conditions, as accurately forecast in 73, were dismal on 15 and 10 meters and forced Gus to spend most of his time on 20, holding forth on 14,000.000001 or so. The phone operation was around 14,106 kHz. Conditions were a bit better on his second stint, fortunately.

ZB2A (F Gordon) has been adding to the 20 meter pileups on weekends. He recently decided, with the help of his QSL manager (WB9WBU), to try the "list" technique. It worked well and the contacts went a lot faster than the usual super-tailend system, with stations tailending each other for minutes at a time to be sure and be the last to transmit.

While operating from JY1, I never let the tailenders get going on me, but I did run into problems with downright callous operators trying to get through no matter who they had to squish to make it and no matter who I asked to transmit. Split frequency helped a bit with this, happily I thought to try getting some of the stronger signals to make up lists for me. This was very fast – the fastest of all.

SVØWU puts through a regular signal from Rhodes, which counts for the Dodecanese Islands, a separate country from Greece. Ike works for the Voice of America there on Rhodes.

9H1G (Joe) and 9H1CE (Bert) have been active recently from Santa Lucia in Malta. Bert is a bit weak with his SB33 and dipole, but Joe runs 300W into a three-element beam and has a substantial signal. 9H1CD is also active. Another rare one in the Mediterranean area is Morocco. (CN2BS (Chris) is doing what he can there to help. OD5BZ (Bob Adams), by far the most active station in Beirut, has now packed up and gone back to W8-land. We will all miss his strong signal. By the way, if you find yourself in Beirut (and who doesn't find himself in Beirut now and then, right?) don't miss the Al Barmaki restaurant. Bob showed me this one and it is great!

again. . .third time since it passed muster as a country. This time ops are OH2BH (Martin) and about ten others – the call is OJØDX. QSL to Angerroti 8B17, Heisimkin 32, Finland.

There are many hints that some OHs will make it down to ZA for the first operation from there in a long time. . .or is it ever? DL7FT was collecting money to go, but nothing came of it and no answers to letters to Frank asking about his plans, the money, etc.

King Hussein has been off the air for a few weeks obviously as a result of the headline problems that have developed in his country. The QSLs have been coming through the bureaus for his contacts and mine from JY1. If you haven't gotten your card yet you either haven't QSL'd to Box 1055, Amman, Jordan as requested, or you have been too cheap to send an envelope to your QSL bureau, or both. I have a personal and vested interest in His Majesty solving his political problems. . .I want to get back to Jordan for another visit perhaps this winter, and I am hoping that an introduction from the King will help me to talk with powers in neighboring Arab countries so I can sell amateur radio.

VR4CG George has been active from Honiara (Box 310) in the British Solomon Islands. I think he must be rare because he is the first VR4 I've heard, ever. He was on 14.231 with a nice S7 signal and not-too-big pileups at 1300Z on a Sunday.

WØMLY (Dick), who runs the Antenna Mart out in Rippey, Iowa, doesn't miss much going on, and has a new one up his sleeve that he hints about, but won't explain. He claims it is new, will count, and that he has the license for it. All he needs is the money, but with collections for DL7FT to go to ZA, Gus to go all over the place, and such, he decided to sit still for a while. Donations have been noticeably harder to get lately, a phenomenon attributable to what some call the "Miller" effect.

ZZ2ERS (PY) says QSL to WB9BWU. ZV7APS did well in the contest and is also from Brazil.

Now that Robby is relatively inactive, even the 5Z4 prefix has rarefied. Chuck, up in Kitale, has been active as 5Z4KM, easing some of the pressure. But I noticed when I operated from 5Z4ERR a couple years back that the pileups were substantial, and again a few weeks ago when Gus stopped there, the pileups were going again. 5Z4 is "medium rare."

LZ1KSZ (Michael) in Stara Zagora (I thought I would mention the city since it has 100,000 population and I'll bet you've never heard of it) started DXing when he was 15, seven years ago. QSL to Box 73. He tells me that the active LZ1s in the club are DG, DK, DO, DL, DJ, DZ, KP, KGZ, KFZ. Most of them are on CW.

VR1L (Bob) is on Ocean Island, one of the Gilbert & Ellice Islands. He most definitely QSLs, through W6NJU. Bob was a new one for me. I missed him one night when he was in QSO with VR1). . .wouldn't that be a nice roundtable to break?

The activity in Turkey has been growing recently, after many years of very sparse contacts. QSL to TA3HD (Hal) vis K3ZPU. Father Moran 9N1MM is on quite often, if you think to point your beam up thataway. He has a good signal and is active enough, along with Jinny, to keep Nepal only medium rare. Afghanistan doesn't come through all that often, but I've contacted a number of fellows up there recently. Probably the most active for me has been YA1GNT (Ed).

Are there any valid contacts being made with China? I doubt it. I suspect that the next BY you hear should be ignored. . .but I'll bet you'll work him "just in case."

I see that K1OTA (Ken) is expecting to be active from 3A2 (Monaco) July 23–27, C31 July 30–Aug 4, LX Aug 6–9, 9H1 Aug 13–16, 3V8 (Tunisia) Aug 21–23. That sounds like a ball.

Germany were issued by the DARC office of International Affairs. All applications for permission to operate in Germany should be sent to DARC International Affairs, Muhlenstrasse 27, D-5601 Doberg, German Federal Republic.

INDIA. During the recent CCIR Plenary Conference held in New Delhi, the Amateur Radio Society of India held a reception for delegates. Among those attending were Brigadier L. King VU2AK, and M.G. Karnik VU2CK, president and vice president of the ARSI. The visitors included RSGB president Dr. John Saxton, and Jack Herbstreit HB9AJI, director of the CCIR. During the meeting a special station (VU2ITU) was in operation.

REPUBLIC OF IRELAND. The address of the official QSL bureau managed by the National Society, the IRTS, remains as 24 Wicklow Street, Dublin 2. Visitors to the republic may obtain, without charge, a temporary license for up to 30 days' operation in any year. Applications should be sent to Department of Posts and Telegraphs, (G.B.) Radio Section, Hammam Buildings, O'Connell Street, Dublin 1. Applications should be made at least one month before the proposed visit. The following information should be given:

1. Date of commencement, and duration of visit.
2. Band or bands to be used.
3. Type or types of emission to be used.
4. Brief details of equipment.
5. If mobile, give make and registration number of vehicle.
6. For fixed operation, give QTH.
7. Holders of UK licenses should send photostat copy of *first page only* of their license or their mobile license.
8. European licensees, send photostat copy of license.

Visiting amateurs will only be afforded those facilities to which their home license ordinarily entitles them.

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73 IS AVAILABLE to the blind and physically handicapped on magnetic tape from: SCIENCE FOR THE BLIND, 221 Rock Hill Road, Bala Cynwyd PA 19004.

RBB-RBC MANUALS, New $5, Used $4. OS-8 Oscilloscope Manual $3. Some QST 1929, 30, 31 etc., Radio 1939, 40 41 etc. Write for list. James W. Holloway W6LFL, 2027 Harton RD., San Diego CA 92123.

FOR SALE OR TRADE National NCX-500, AC500 Power Supply, 100 Kc XT1. Marker — 6 mos. old. Sacrifice $335 complete. Will trade for video tape recorder — going strictly 2 meters. K9GJM, 1113 Laurel, Highland IL 62249.

"TOWER HEADQUARTERS!" 11 brands! Heights aluminum 35% off! Strato Crank-ups-low cost! Rotors, antennas and gear discounts. Phone patch $11.95. Catalog-20¢ postage. Brownville Sales Co., Stanley WI 54768.

COLOR ORGAN KITS $3.25 up. IC Power supplies $2.75 to $8.50. Computer grade electrolytic capacitors $.35. YMTR transistor TRW PT3690 $4. Catalog. Murphy, 204 Roslyn Ave., Carle Place, NY 11514.

NOVICE CRYSTALS: 40—15M $1.33, 80M $1.83. Free flyer. Nat Stinnette Electronics, Umatilla FL 32784.

HT37 $175, SX101A $165, Linear Systems. 500 D.C. Supply $65, Waters Antenna 80 — 10 meters $35. R. Stanzak 47—6A Norstar Blvd. Liverpool NY 13088.

WORLD RADIO'S used gear has trial-terms-guarantee! HX30 (6M-SSB) - $199.95; RX1 - $149.95: Swan TV2 - $199.95; 350 - $279.95; DuoBander 84-$104.95; T4X - $299.95; HQ110C - $139.95; HQ170C - $179.95; NC300 - $139.95; Galaxy 5mk3 - $279.95; SB33 - $189.95; SB34 - $249.95; GD104 (mic-stand) $19.95. Free "blue-book" list for more. 3415 Broadway, Council Bluffs IA 51501.

FM PICNIC Sunday August 2, near Angola, Indiana. Big prizes, free flea market, entertainment for the ladies and kids. Picnic grounds, campsites, boating, food, soft drinks available, rain or shine. Call in freq. 146.34/146.76, 146.94, 52.525. For information contact Fort Wayne Repeater Assn., Box 6022, Fort Wayne IN 46806.

FM SOLID STATE ICE TRANSCEIVER on 146.34, 146.76, 146.94 mc, like new $150. PMR-8 Receiver $35. S38 Receiver $25. W.Davis 4434 Josie Avenue, Lakewood CA 90713.

POLYCOMM PC 62B: 6 & 2 mtr. transcvr. Built in AC, DC, squelch mike, and separate VFO. with 7 element beam: xclnt: $175 WB6UWJ (213) 287—4423.

SWAN 250C with noise silencer, mint condition, cost new $486.00, used 23 hours, now $350.00, plus shipping. Globe vox 10 $11.00, Drake low pass filter tv-1000 $11.00, Ameco low pass LN2 $5.00, new National Schools 3 band receiver $20.00. Kenneth Massie, 115 Woodlawn Drive, Ironton OH45638.

FOR SALE: SSB-CW Rig. 2kw PEP. 80 thru 10 meters. SASE for specs, pic. $650 or best offer. G. Powerll, Rt. 11, Beattyville KY 41311.

THE FRRL HAMFEST, will be held at Phillips Park in Aurora, Illinois, on August 23. Free coffee and donuts will be served from 9:00 to 10:00 AM. Advance tickets $1.00, $1.50 at the gate. Talk-in frequencies: 145.35, 146.94, 3.94 Mcs. For further information, contact, Tom Rogers, WA9WBV, Box 323, Oswego IL 60543.

QSL CARDS? Samples 25¢. (deductable). Sakkers, W8DED, Holland, Michigan. (mention "73" magazine).

FOR SALE: RCA WR99A Crystal Calibrated Marker Generator $150. Never been used, new Bands. Ralph M. Williams, Box 372, Dixfield MA 04224.

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"HOSS TRADER ED MOORY" says he will not be undersold on Cash Deals: Shop around for your best cash price and then call or write the "HOSS" before you buy! **New Equipment:** Factory Warranty: Early Model Swan 260 Cygnet with microphone, ($435.00) Cash Price $339.00: New Gonset GSB 201 MkIV Linear, 2000 Watts, ($495.00), Cash Price: $295.00: New Swan 350C, ($420.00), Cash Price $339.00: New Rohn 50 ft. Foldover Tower Prepaid, $199.95: New Mosley Classic 33 and Demo Ham-M Rotor, $198.00: **Used Equipment:** R4, $259.00: L40B, $549.00: TR-4, $419.00: 500C, $375.00: 75A-4, $319.00: HT-37, $169.00: **Two Locations:** Moory Electronics, Phone (501) 946—2820, P.O. Box 506, Dewitt AR 72042; Moory Electronics. Bill Davaul (W5FQX), 415 W. 33rd, N. Little Rock AR.

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Classified

Caveat Emptor?

Price — $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agencydiscount. Include your check with order.
We cannot check into each advertiser, so Caveat Emptor. . .

73 IS AVAILABLE to the blind and physically handicapped on magnetic tape from: SCIENCE FOR THE BLIND, 221 Rock Hill Road, Bala Cynwyd PA 19004.

RBB-RBC MANUALS, New $5, Used $4. OS-8 Oscilloscope Manual $3. Some QST 1929, 30, 31 etc., Radio 1939, 40 41 etc. Write for list. James W. Holloway W6LFL, 2027 Harton RD., San Diego CA 92123.

FOR SALE OR TRADE National NCX-500, AC500 Power Supply, 100 Kc XT1. Marker — 6 mos. old. Sacrifice $335 complete. Will trade for video tape recorder — going strictly 2 meters. K9GJM, 1113 Laurel, Highland IL 62249.

"TOWER HEADQUARTERS!" 11 brands! Heights aluminum 35% off! Strato Crank-ups-low cost! Rotors, antennas and gear discounts. Phone patch $11.95. Catalog-20¢ postage. Brownville Sales Co., Stanley WI 54768.

COLOR ORGAN KITS $3.25 up. IC Power supplies $2.75 to $8.50. Computer grade electrolytic capacitors $.35. YMTR transistor TRW PT3690 $4. Catalog. Murphy, 204 Roslyn Ave., Carle Place, NY 11514.

NOVICE CRYSTALS: 40—15M $1.33, 80M $1.83. Free flyer. Nat Stinnette Electronics, Umatilla FL 32784.

HT37 $175, SX101A $165, Linear Systems. 500 D.C. Supply $65, Waters Antenna 80 — 10 meters $35. R. Stanzak 47—6A Norstar Blvd. Liverpool NY 13088.

WORLD RADIO'S used gear has trial-terms-guarantee! HX30 (6M-SSB) - $199.95; RX1 - $149.95: Swan TV2 - $199.95; 350 - $279.95; DuoBander 84-$104.95; T4X - $299.95; HQ110C - $139.95; HQ170C - $179.95; NC300 - $139.95; Galaxy 5mk3 - $279.95; SB33 - $189.95; SB34 - $249.95; GD104 (mic-stand) $19.95. Free "blue-book" list for more. 3415 Broadway, Council Bluffs IA 51501.

FM PICNIC Sunday August 2, near Angola, Indiana. Big prizes, free flea market, entertainment for the ladies and kids. Picnic grounds, campsites, boating, food, soft drinks available, rain or shine. Call in freq. 146.34/146.76, 146.94, 52.525. For information contact Fort Wayne Repeater Assn., Box 6022, Fort Wayne IN 46806.

FM SOLID STATE ICE TRANSCEIVER on 146.34, 146.76, 146.94 mc, like new $150. PMR-8 Receiver $35. S38 Receiver $25. W.Davis 4434 Josie Avenue, Lakewood CA 90713.

POLYCOMM PC 62B: 6 & 2 mtr. transcvr. Built in AC, DC, squelch mike, and separate VFO. with 7 element beam: xclnt: $175 WB6UWJ (213) 287—4423.

SWAN 250C with noise silencer, mint condition, cost new $486.00, used 23 hours, now $350.00, plus shipping. Globe vox 10 $11.00, Drake low pass filter tv-1000 $11.00, Ameco low pass LN2 $5.00, new National Schools 3 band receiver $20.00. Kenneth Massie, 115 Woodlawn Drive, Ironton OH45638.

FOR SALE: SSB-CW Rig. 2kw PEP. 80 thru 10 meters. SASE for specs, pic. $650 or best offer. G. Powerll, Rt. 11, Beattyville KY 41311.

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EDITORIAL BY WAYNE GREEN

The ITU Problem

Those of you who have been following my editorials down through the years will find this piece a bit repetitious, but perhaps thought provoking.

The most important result of my visit to Jordan was not the contacts that I made or even the setting up of that country with an amateur radio service, it was the vote at the ITU that amateur radio will have from Jordan. Amateur radio has scant support from the African and Asian countries and needs every vote it can get from them.

The source of our amateur frequencies, as I am sure you know by now, is not the Federal Communications Commission, but the International Telecommunications Union in Geneva. The ITU has little organization in itself, being made up mostly of representatives of the many countries of the world who get together in Switzerland every so often to agree (and disagree by way of footnotes in the articles of agreement) about all matters having to do with international communications.

The last ITU conference which was scheduled to take up reallocations of the amateur bands was in 1959. Both John Huntoon and I had the honor of attending this conference as representatives of amateur radio. The only other such representative from our country was W1BUD, but he was very "sick" at the time and was unable to participate much. The allocation of shortwave frequencies was set aside at this conference, leaving the fate of our bands to the next conference which was expected to come along in the mid 60s.

The emergence of many African nations upset the balance of power in the ITU, shifting it from the European countries to the African–Asian countries, with the result that further conferences of the ITU were blocked at every turn by the Europeans. When you consider the decimation of the amateur frequencies proposed by some of the African–Asian countries at the 1959 conference, the delay has been most fortuitous for us.

Since no country has been able to develop its electronics and communications without a healthy amateur radio population to provide the technicians and engineers, we have a terribly important message for all the emerging and developing nations. . .push amateur radio and push it hard or else be prepared to take a back seat to those countries that do. It is reasonable . . .it is logical. . .and the proof is plain to see: those countries that have encouraged amateur radio have been able to develop because they have engineers and technicians to provide the communications which are the most basic ingredient of development.

I do not believe that it is any accident that the industrial development of most countries is parallel to the number of radio amateurs they have licensed. Obviously it is of extreme importance to get this message to the leaders of the emerging countries. Has anything much been done to do this? The answer, as you again know, is a sad no. . .little has been done.

A man of stature is needed for this task. . .one who can not only get in to see the rulers of these countries, but one who will be listened to when he gets there. It is extremely unfortunate that Herbert Hoover Jr., the past president of the ARRL, did not undertake such a goodwill and promotion trip. The money was there for it – $100,000 was set up for just such a thing – but for some reason it never came about. About the only other radio amateur of such an international stature is Senator Barry Goldwater, but I'm afraid that his work in Washington may preclude his setting out on the long and difficult trip that is called for.

I hope that His Majesty King Hussein will not mind my mentioning him, but he quickly grasped the importance of amateur radio to the development of his country and moved immediately to set up the hobby there. I am in hopes that through his understanding and friendship I will be able to visit some of the other neighboring Arab countries and try to set them up with a healthy and expanding amateur service. This will not only help the countries involved, but it will give us a good guarantee of the votes that we desperately need in Geneva.

Unfortunately, I have neither the time nor the money to even make a decent try at promoting amateur radio in but a small percentage of the countries where the effort should be made. I enjoy this sort of thing, but until subscriptions come in a lot faster and advertisers consider it a

lot more important to support 73 than they do now, I'm busy paddling upstream for all I'm worth just to stay in one place. As soon as I rest for a day or so the falls just downstream come closer, if you'll excuse the metaphor.

I hope that I can mention the ARRL at this time without some readers feeling that I am tearing it down. The ARRL, for all of the good things that it is doing, is not yet perfect. . .I hope that even the most prejudiced Leaguer will agree to that. This means that there are areas where some improvement can be made. Is it destructive of me to point these out?

Since the ARRL has set aside $100,000 for the defense of our amateur frequencies it seems logical to me that it is up to them to make a definitive move in this direction. Their position as the national society for the U.S. and their control of the IARU would seem to automatically elect them for this position. They have expended $37.586.48 (according to the last ARRL report) towards this goal during the last few years, though I haven't yet seen an accounting for it. If you are able to get an accounting I would appreciate your passing it along to me. I'm sure that this money was not just spent on vacation trips by the HQ brass. But I'm not certain. Unaccounted large sums like that worry me. No public corporation would be able to hide something like that from its stockholders, so why should ARRL be able to sweep it under the carpet.

The problems at 73 have prevented me from getting over to visit and talk with the current secretary general of the ITU. I did manage to talk quite a bit with two previous secretaries general and found them both very interested in the idea of developing amateur radio in the backward countries as a key means for getting technicians and engineers in those countries. I proposed that the ITU establish a simple set of amateur radio regulations for application in small countries and this was in the works with the last secretary general. This would in essence put the prestige of the ITU behind amateur radio and help our hobby to expand. I am sure that this could be set in motion with the new secretary, if someone could sit down and put the proposition to him.

The ARRL board of directors has been peculiarly silent about this responsibility of the League. This is hardly a problem that can be ignored or just not faced because it is difficult. Since HQ seems to have done little on its own initiative, it is up to the directors to force the HQ boys into action. And it is up to you, the members, to force the directors into action. The next time your director shows up at your club, ask him for an accounting of the $37,000. . .HQ certainly hasn't kept that much money a secret from him. . .and exactly what the League proposes to do about getting votes at the ITU. . .and, incidentally, why he did absolutely nothing at the last board meeting about getting even one man in Washington as a lobbyist for amateur radio!

As long as the League has a net loss each year, even though it is minuscule, it is simple to avoid both tax problems and demands from the members for added services such as public relations, lobbying, etc. The loss last year was, as usual, quite small, less than $50,000 on a turnover of well over $1.5 million. It was also quite unnecessary. There is some $500,000 sitting around doing very little except turning into dollarettes that could be used for the promotion and furtherance of amateur radio. There are also any number of ways that money could be saved, as I am sure your director will have to admit if you corner him, which would provide funds for the benefit of our hobby.

While you are asking your director questions, there are a few others that you should bring up. For instance, if you read the annual report you will find that the publication expense for QST last year ran an average of $32,666 per month. That may not sound too bad, considering the costs of business today, but I will tell you that I could put out the same number of copies with the same number of pages for just about half that. $15,000 a month or so is being blown somewhere and you deserve to know who is getting all that money and why.

Part of the loss is because QST is just a bit bigger than the other three amateur magazines. This little bit extra means that QST will not quite fit on the modern presses and thus has to be run in smaller sections. This increases the cost greatly.

Undoubtedly QST's change to doing their own typesetting will bring about some savings for this year over last. But why was QST the last ham magazine to put in the IBM typesetting system? 73, by the way, was the first. Ask your director about this.

You might ask your director why QST is ten years behind the times in the paper it is using too. The ARRL could save thousands of dollars a year by changing to a more modern type of paper. The paper manufacturers have not been sitting idle; they have been inventing lighter and better papers, with no sacrifice in opacity, and they cost a lot less than the old-fashioned papers.

Just think what good could be done with the nearly $200,000 a year that might be saved in the publishing of QST! A small fraction of that would keep a man on the road visiting foreign governments on the behalf of amateur radio on a year round basis. Another fraction would buy us publicity and promotion for amateur radio in the top mass-circulation magazines. Ask your director about this and listen very carefully to the explanation.

Again, please let me emphasize that the above is written in the spirit of constructiveness, recognizing that no organization, not even the ARRL, is absolutely perfect and above improvement. You should recognize that it is unlikely that

(cont. on page 81)

Repeater Update

At a recent FM forum, Bob Peterson K2IEZ asked me why I never included in the periodic repeater directory systems that required the use of continuous subaudible tones. I emphatically told him – and the others present – that I would not list such repeaters because they could not realistically be considered as open repeaters. Continuous tone – unlike tone-burst entry – involves some rather precision tone generation equipment. Levels for continuous tone (PL) are unusually critical, and even an error of 0.5 Hz will keep the user from being repeated.

Well, since the forum I've had a change of heart. FM isn't quite the new thing that it was a few years ago. More and more repeaters are going up, and they're going up more and more frequently with overlapping coverage areas. In many cases, use of PL is the only practical means for avoiding interference with adjacent repeaters.

So, while I would still like to discourage the use of PL (because PL itself discourages newcomers from getting a taste of the fun of repeater operation), I will include PL repeaters in the directory, regardless of frequency of operation. The only requirement for directory listing is that the PL frequencies must be included along with the operating frequencies.

If you operate a repeater that welcomes transients, write the particulars on a sheet of paper or a postcard and send it to 73 right away. We are currently preparing a repeater directory "update," and want to make it as accurate as possible. We want to list all open repeaters, on 6 meters, 2 meters, or 450 MHz. But hurry – we don't have a lot of time.

The Busiest Check Around

When I returned from the Orlando hamfest, 73 gave me a $10 check as reimbursement for some out-of-pocket expenses I'd incurred in Florida. But rather than cash the check, I kept it in my wallet for a few days.

Then, when Betty Daniel WB6AOF, a friend of mine from California, spent nearly $10 to mail me an airmail package from my home town, I just endorsed the 73 check and mailed it to her.

Betty's husband, Fred Daniel W6NQS, owed Don Milbury W6YAN $10 for a crystal purchase Don had made. So, since it was Fred's money that had paid for the mailing of my package anyway, he asked his wife to sign the check over to Don–which she did.

But Don was interested in getting a subscription to 73 Magazine, so he endorsed the check and sent it back to its home in Peterborough.

The story doesn't end here, though. That crystal that Fred bought from Don was really from Wayne Green's Handie-Talkie. Fred is owner of Communications Specialties, the company that put Wayne's Handie-Talkie on frequency. Since Fred had paid for the crystal, he sent Wayne a bill from Communications Specialties for $10. Guess what check was used to pay that invoice.

A Free Plug (It's a Pun)

If you've recently purchased a Galaxy FM-210 2 meter FM transceiver, you've no doubt learned that it comes less microphone. The unit has a PL-68 receptacle built into the front panel and is designed for a high-impedance ceramic or dynamic mike. When Wayne and I bought our FM-210's, Wayne had the foresight to order a couple of push-to-talk mikes from Meshna Surplus (Box 62, E. Lynn, Mass. 01904).

These mikes warrant mention because they sell for only $5. They are attractive, hand-held jobs with built in push-to-talk switch and an ample length of three-conductor curly-cord. I rate it as a great buy. The fellows from Meshna say they'll throw in a PL-68 plug, too, if the buyer states the mike is for an FM-210 (while Meshna's PL-68 supply lasts, that is).

Another commodity we picked up from Meshna that should be of particular interest to FM'ers (because of the FM'ers lust for frequency stability) is tunable NPO capacitors. Meshna sells these individually (3–12 pF) for 25 cents, or in "banks" of 24 for $3. The 24-bank array includes five 3–12 pF, fourteen 5–25 pF, and five 8–50 pF. I bought a batch of these to replace some rather questionable "original equipment" variables.. (The banks, by the way, are difficult to separate into individual capacitors).

Repeater Users!

Last chance to correct 73's listings for your area. A new *repeater update* is being prepared for publication in an upcoming issue. If your repeater has not yet been listed, mail complete info to Repeater Directory, 73 Magazine, Peterborough N.H. 03458. Include repeater call, area served, tones required (if any), essential data (narrow or wide, times of operation, etc.), input and output frequencies. Do it now!

73 Repeater Slide Presentation

73 would like to make up a tape-and-slide presentation for use by radio clubs across the country. If you'd like your repeater featured, send us a few representative 35 mm slides with explanatory or descriptive information. We'll combine yours into the "carousel" and work your information into the story.

. . . K6MVH ■

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By unofficial count, and with some willfully inaccurate exaggeration thrown in for good measure, I estimate that there have been approximately 673,492 references in the press respecting pollution of the environment. Of this, about half has dealt with air pollution, slightly less with water impurification, and the remainder with adulteration of food, indiscriminate spraying for insect pests, noise, and other miscellaneous types of environmental deterioration. The least mentioned item in the list has been noise pollution, meaning the clatter of garbage trucks, automobile horns, compressed air drills, blasting, fire sirens, sonic boom, city buses, cats serenading from back-alley fences, and Puertoricquenos playing bongo drums and guitars on the sidestreet stoops of the city after midnight.

In very few instances can I recall any mention of a specific form of atmospheric despoliation with which we radio amateurs are vitally concerned; namely the pollution of the airwaves in the form of unwanted hash on the station receiver. Apart from ordinary, everyday QRM and QRN, we are forced to contend with a veritable smorgasbord of obstreperous sounds, any one of which is guaranteed to drive you stark, staring mad in a trice, or a couple of trices. There's ITV, from those verdammte 15,000 Hz horizontal TV oscillators; IDD, from misbehaving diathermy devices; INS, from malfunctioning neon signs in bars and grilles; IVW, from the hot ignitions of Volkswagens and other foreign compact cars; IBI, from broken insulators on power poles; IEB, from electric blankets; IRT, from refrigerator thermostats; ICO, from can openers; ISM, from sewing machines; and even IRCBPBASORASLH, interference from rectification caused by poorly bonded aluminum siding on ranch and split level houses! We have no shortage of supply; noise in this society is as ubiquitous as was horse manure to an earlier age, before the proliferation of mechanized modes of conveyance. But, at least the manure nourished entire generations of English sparrows. Of noise, very little good can be said!

Everybody is jumping on the antipollution bandwagon! President Nixon in his state-of-the-union speech last winter said that his Administration is determined to come to grips with the problem of our air and water. The late Rachel Carson, in her books *Silent Spring*, and *The Sea Around Us*, dealt in great detail and depth with pollution's awesome effects upon our ecology. And the redoubtable Ralph Nader has been wielding his cudgel against the unscrupulous culprits who have been sullying out food supply with harmful chemical additives. The conservationists campaign against our traditionally lackadaisical apathy, and it is difficult nowadays to find a single newspaper or magazine in which the subject is not discussed. But hardly a soul, except some lone, isolated acoustical engineer, writing a monograph for a ceiling tile manufacturer, has seen fit to spell out the dimensions of the noise menace in all its truly perilous proportions. In addition to all the other types of noise pollution, something must be done about the lousing up of the radio waves.

By this time we all recognize the power of small but vocal minorities. Once the public becomes aroused and angry... once the sleeping giant awakens... there's very little he cannot accomplish. Indignant nature lovers, in a tizzy over plans to build an atomic power plant on the majestic Hudson at Storm King Mountain, raised incredible furor. Even disreputable looking, bearded, guitar-playing folk singers joined the crusade. Despite a company sponsored survey which showed that only very minute thermal changes would occur, and guaranteed only minimal deleterious effects upon the fishes of the river, the antagonists have so far successfully withstood all efforts to establish this installation, and it remains an unfulfilled dream to this very day...a monument to the irresistible power of public indignation. The righteously wrathful spirit of Carrie Nation rides abroad throughout the land. And woe betide any would-be opportunist who stands in its path!

When TVI occurs and customers complain, manufacturers of TV sets supply free components to clear up the problem. Why are they permitted to omit the highpass filters at the factory? Because it's an economic factor, of course. But, isn't it ridiculous to have to deal with each and every situation on an individual basis? Well, just suppose the problem never materializes on a high proportion of the sets? For each of these trouble-free sets the manufacturer saves the cost of such preventive components, resulting in a not inconsiderable aggregate total.

(cont. on page 63)

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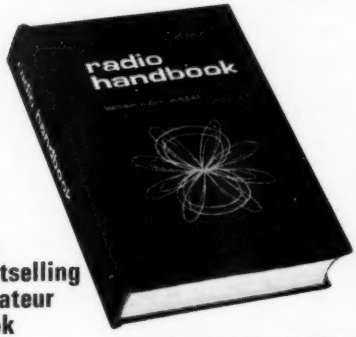

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After several years in the automobile radio field and almost ten years in amateur radio, the author supposed that he had seen just about every atrocity that can possibly be committed in the mobile mounting of a piece of auxiliary electronics equipment. This assumption is constantly proved wrong by new installations that range from the tragic to the immensely funny! The truth is that a little forethought and some basic craftsmanship will prevent most of the headaches usually cited as objections to mobile operation.

Placement of Unit

For this discussion we will define "main unit" as a transceiver, receiver/transmitter combination (such as was popular a few years ago), or other unit. Specifically excluded for the time being are the various remote control schemes commonly associated with trunk-mounted FM equipment.

Placement, in some cases, is often the most discouraging pitfall encountered during a mobile installation. Automobile manufacturers have displayed a positive genius for frustrating the plans of all but the most ardent mobile operators. They have designed auto interiors in such a way as to eliminate any possibility of mounting a mobile rig anywhere but in the trunk! Some of the problems encountered in trying to solve this particular pitfall include dashboards with inadequate strength or insufficient mounting space, transmission "tunnels" of odd shape or size, and general lack of room between the accesory panels and the floor.

The main considerations for determining placement are safety and convenience. The rather obvious assumption that excessive reaching while driving can be fatal sets a requirement that the unit be placed within nonstraining reach of the operator (unless, of course, no in-motion operation is contemplated). It is also a good idea to make sure that lacerated

knees and torn stockings don't result from the installation. In a one-car family, such can be the spark that ignites a disruption of domestic tranquility!

If a dashboard mount is impossible, the transmission tunnel may be adequate. A surprising number of installers overlook this possibility by not knowing that most of the mounting brackets supplied with modern transceivers can be attached from either the top or the bottom. Even if this is not the best method of mounting, a little imagination and a few odds and ends will improve the situation.

Dash Mounted Units

The most usual mounting method is the familiar "U" or channel bracket suspended from the underside of the dashboard. This bracket is fastened with screws to both the dashboard and the mobile unit (Fig. 1). A mistake that is often made is the use of too lightweight a screw. The best are machine screws fastened with a star washer and two nuts. It is, however, not always possible to use this method. If, for instance, the upper side of the dashboard lip is inaccessible, then self-tapping screws are in order. Whichever fastener is decided upon must be substantial enough to hold the unit securely. Lightweight units can be held with a No. 10 screw; heavy units with a No. 12. If a larger screw is required for any particular unit, then there are serious doubts as to the dashboard's ability to support the unit.

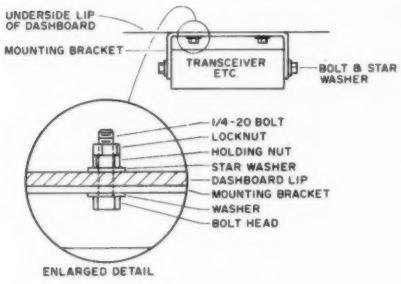


Fig. 1. With lightweight, low-power mobile transceivers, a simple mounting bracket can suspend the unit. The rear of the transceiver can be held with a bracket fixed to the firewall.

Floor Mounting

If, for any reason, the rig cannot be suspended from the dashboard, a good alternative is the transmission tunnel. As mentioned before, most brackets can be upended and installed from the bottom.

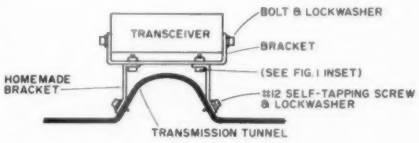
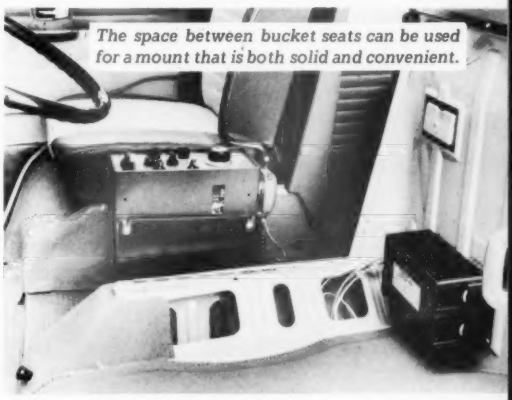


Fig. 2. Since most transmission humps differ in size and configuration, mounting here usually requires a bracket of special design. A little metal work, though, will result in a very effective and solid installation.

Figure 2 illustrates one possibility. The rig may be mounted either horizontally or vertically (perhaps resting against the seat). Again, screws that will bear the load are essential. (If your car has carpets instead of rubber floor mats, DO NOT USE A DRILL to make holes for the screws. The carpet thread will wind up around the drill bit creating a very amusing pattern in your once conservative rug.)



The space between bucket seats can be used for a mount that is both solid and convenient.

In some bucket-seat vehicles such as the van shown in the photos, an ideal installation is the area between the driver's and passenger's seat. Many transceiver manufacturers also produce brackets that result in a sturdy installation yet which permit quick removal of the unit.

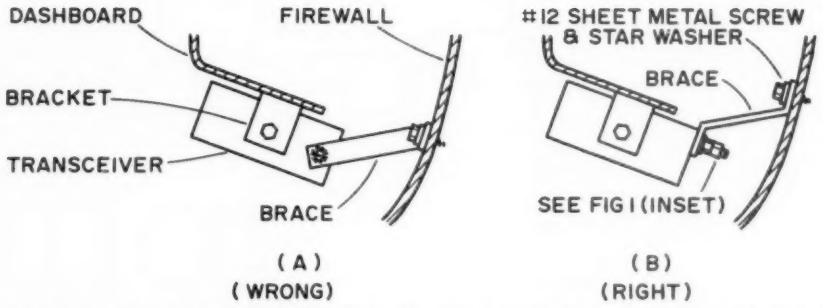


Fig. 3. The bracket at the rear of the unit should be placed near the center of the transceiver's back plate, as shown here. If a single bracket is mounted at the side, an undue strain is placed on the front bracket and the unit can vibrate loose in a short time.

Bracing

Vfo stability, the continued good health of the rig, and some safety considerations depend in large measure on the stability of the installation. It is surprising that some operators will sacrifice the good repair of their unit (vibration plays hob with electronics gear) for the relative ease of a braceless installation. A piece of stiff metal pipe strap, a length of angle stock, or any substantial material can be used, depending on the particular situation. It may, in some cases, be necessary to drill a hole in the rig to provide for such a mount. Some reputable manufacturers overlook this necessity because mobile operations are a second thought. A ¼-20 screw is preferred for this use. Figure 3 shows right and wrong ways to make a brace.

Speakers

With the advent of automotive stereo tape players, there have been a large number of speaker mounting systems introduced that are possibly better than the traditional mobile speaker. These usually can be mounted behind the dash completely hidden from view. Care should be exercised in selection of these units not to obtain one of the door mounting units. Most cars use the door interiors as a rain drain, making it a rather unhealthy place for loudspeakers. Check out auto radio and other stores that deal in tape players. They should have a stock of such mounts. You should remember that your best bet is to have the speaker pointed toward your ears. The audio you'll be listening to is not hi-fi, and you'll need as much intelligibility as you can get.

Antennas

A discussion of antenna techniques deserves a treatment of its own. Such a treatment is given in both the *Radio Amateur Handbook* and the *Mobile Manual*. The only comments appropriate here are a matter of opinion. There should be a definite trend away from bumper mounted antennas. They are a lot less substantial and a whole lot more aggravating than other types. As for the objection to cutting a hole in the body of a car, it is of little importance in most cases. Holes can sometimes be filled at low cost.

Power Considerations

Except for taking care to mount power supplies where good ventilation is provided and passengers' feet avoided, there is not much to mounting power supplies that

With the seat in place (covering the Drake's power supply), the power cables and antenna lead-in are out of sight. The microphone drops out of the way, too, and clips onto the side of the rig. (Probably the most important single consideration with any mobile setup is microphone cable routing. Lack of care in underdash rigs can lead to steering wheel entanglements and other such embarrassments.)

cannot be inferred from the above paragraphs and photos.

Another case entirely is the power supply hookup. Rigs in the CB power class can be hooked up through the auto ignition switch, even though it is *not* recommended. This is accomplished by locating the accessory terminal of either the switch or the fuse block.

A higher power rig (as most are these days) must be hooked directly to the battery with wire heavy enough to carry the current load without heating up or causing an intolerable voltage drop. Remember, a rig that requires 200W of line power will draw almost 17A at 12V. The nature and cost of high-amperage switches makes relay control look better from many standpoints. In general, it is *not* a good idea to connect the power lead to the fuse block. Run it straight to the battery of the battery terminal on the engine starting solenoid.

One often overlooked problem regarding the power hookup concerns the possibility of picking up motor noise transients. All wires that are run through the engine compartment have the potential of picking up noise. Under all circumstances these leads should be dressed away from the ignition coil and its associated wiring. Shielding is also desirable. The shielding braid on the larger sizes of coaxial cable may be of sufficient diameter to handle the current drawn by a low- to medium-power rig.

The long multiconductor harnesses usually associated with trunk-mounted

The biggest problem of vertically mounted rigs is that the operating panels tend to collect dirt. A dust cover will keep dirt out effectively and will reduce the chances of someone spilling coffee or cola onto your new Drake. The inexpensive cover also discourages tampering and accidental knob-bumping.

The antenna warrants a great deal of thought. It should be mounted as far from the road as possible to minimize noise pickup; it should extend as high above the vehicle as practicable. Both these objectives are achieved in this Volkswagen installation, where a special plate is installed for mounting the Hustler antenna away from the vehicle body. This type of installation requires some weatherproofing where the coax feeds the spring base.

installations should never be run down the same side of the car as the normal automotive wiring. The proximity is likely to cause noise pickup by mutual coupling. A more complete treatment of noise problems can be found by consulting the *Handbook, Mobile Manual*, and the author's article in *QST* (July, 1968).

Preparation

One of the prerequisites for any major project is preparation. For a mobile radio installation a good selection of tools is essential. An electric drill with a collection of bits suitable for the uses that will be encountered, a collection of wrenches and other hand tools, and a reasonably good place to work will make the job a whole lot easier. A comprehensive study of the *ARRL Mobile Manual* and appropriate sections of the *Handbook* are both likely to help the mobile aspirant to avoid some of the mistakes that are made all too often. These publications also contain information that will aid in making some of the decisions and choices that inevitably pop up from the very beginning of such projects. . . . K4IPV ■

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SB-102 SPECIFICATIONS — RECEIVER SECTION — Sensitivity: Better than 0.35 microvolt for 10 dB signal-plus noise to noise ratio for SSB operation. **SSB selectivity:** 2.1 kHz minimum at 6 dB down, 5 kHz maximum at 60 dB down — 2:1 nominal shape factor — 6:60 dB. **CW Selectivity:** (With optional CW filter SBA-301-2 installed) 400 Hz minimum at 6 dB down, 2.0 kHz maximum at 60 dB down. **Input impedance:** Low impedance for unbalanced coaxial input. **Output impedance:** Unbalanced 8 and 600 ohm speaker, and high impedance headphone. **Power output:** 2 watts with less than 10% distortion. **Spurious response:** Image and IF rejection better than 50 dB. Internal spurious signals below equivalent antenna input of 1 microvolt. **TRANSMITTER SECTION: DC power input: SSB:** 180 watts P.E.P. continuous voice. **CW:** 170 watts — 50% duty cycle. **RF power output:** 100 watts on 80 through 15 meters; 80 watts on 10 meters (50 ohm nonreactive load). **Output impedance:** 50 ohms to 75 ohms with less than 2:1 SWR. **Oscillator feedthrough or mixer products:** 55 dB below rated output. **Harmonic radiation:** 45 dB below rated output. **Transmit-receive operation: SSB:** Push-to-talk or VOX. **CW:** Provided by operating VOX from a keyed tone, using grid-block keying. **CW side-tone:** Internally switched to speaker in CW mode. Approx. 1000 Hz tone. **Microphone input impedance:** High impedance. **Carrier suppression:** 50 dB down from single-tone output. **Unwanted sideband suppression:** 55 dB down from single-tone output at 1000 Hz reference. **Third order distortion:** 30 dB down from two-tone output. **Noise level:** At least 40 dB below single-tone carrier. **RF compression (TALC):** 10 dB or greater at .1 ma final grid current. **GENERAL: Frequency coverage:** 3.5 to 4.0; 7.0 to 7.3; 14.0 to 14.5; 21.0 to 21.5; 28.0 to 28.5; 28.5 to 29.0; 29.0 to 29.5; 29.5 to 30.0 (megahertz). **Frequency stability:** Less than 100 Hz per hour after 10 minutes warm-up from normal ambient conditions. Less than 100 Hz for ±10% line voltage variations. **Modes of operation:** Selectable upper or lower sideband (suppressed carrier) and CW. **Visual dial accuracy — "resettability":** Within 200 Hz on all bands. **Electrical dial accuracy:** Within 400 Hz after calibration at nearest 100 kHz point. **Dial mechanism backlash:** Less than 50 Hz. **Calibration:** 100 kHz crystal. **Audio frequency response:** 350 to 2450 Hz ±3 dB. **Phone patch impedance:** 8 ohm receiver output to phone patch; high impedance phone patch input to transmitter. **Power requirements:** 700 to 800 volts at 250 ma; 300 volts at 150 ma; —115 volts at 10 ma; 12 volts at 4.76 amps. **Cabinet dimensions:** 14⅞" W x 6⅝" H x 13⅜" D.

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Bill Hoisington K1CLL
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Amateur Wattmeter for $3.85

. . . tells you your power output from 10 mW to 5 watts, over the range from 160 meters up through 450 MHz

This article describes a very useful gadget for determining the rf power output of solid-state VHF–UHF transmitters in the difficult range to measure, from about 10 mW up to 5 watts. It does not read watts directly; but by a simple comparison of calibrated pilot light brilliance, it will tell you how many watts you are putting out, to within less than 5%. It allows you to check power increases and estimate your efficiency quite close.

Principle Involved

We'll start right in with this part because, while this unit is not by any means a "trick," it does not read rf directly. You first light a pilot light as a good dummy load, matching it into the rf tank circuit of your transmitter by the normal means, also noted here.

You then switch on a second bulb of the same type by means of a battery, controlling the light output with a $1.30 wirewound potentiometer in series, as shown in Fig. 1. This pot must be previously calibrated in milliwatts, as by the method of "volts times milliamperes equals milliwatts." You then match the brilliance of the bulb lit up with rf or its dull glow at some 18 to 25 milliwatts if you're just getting your transmitter going, and read the watts on the wattmeter dial. It's astonishing how well it works, how repeatable it is, and how you wouldn't be without it once you build and calibrate it.

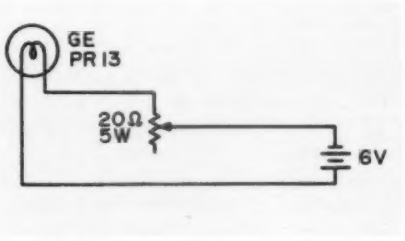


Fig. 1. The circuit supplies the brilliance "standard" for comparison. When the "standard" lamp is mounted adjacent to the dummy load, the pot permits variation of the standard to match the load. If the resistance is panel-marked in watts, a good power indication is achieved.

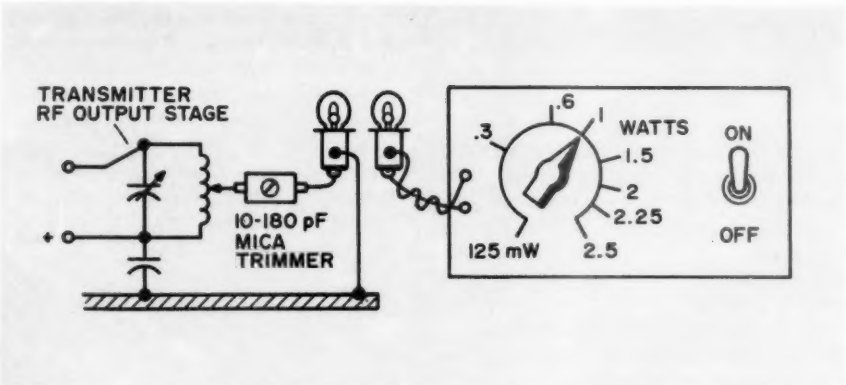


Fig. 2. A series capacitance loads the rf indicator for comparison. The capacitance value will decrease inversely with frequency increases.

Brilliance Standard

Figure 2 tells almost the whole story at a glance. You can, of course, put as much calibration on the dial as you have time for. It is quite important to orient the bulb filaments in the same relation to your eyes for best matching. There isn't much in back of the panel except one 6V battery which can be obtained in any hardware store.

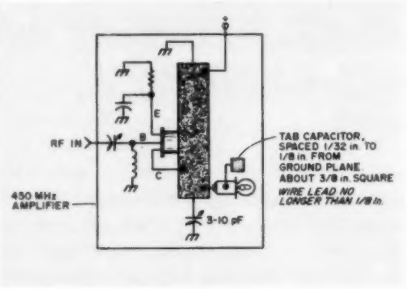

RF IN
450 MHz
AMPLIFIER
TAB CAPACITOR, SPACED 1/32 in. TO 1/8 in. FROM GROUND PLANE ABOUT 3/8 in. SQUARE
WIRE LEAD NO LONGER THAN 1/8 in.
3-10 pF

Fig. 3. Matched pilot light load for the UHF version.

RF Matching

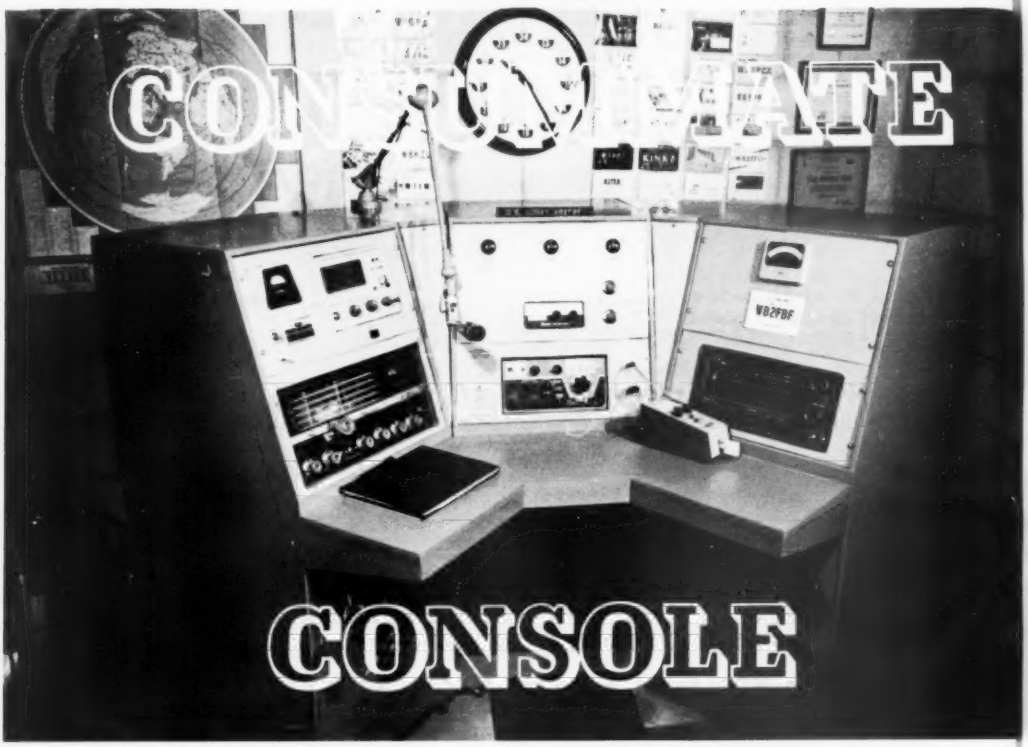
Not that it is particularly critical, but be sure and note the need for a large range of series capacitors for the rf pilot lights as you go up in frequency. This can be seen clearly in Figs. 2 and 3. The block diagram, Fig. 2, shows a 6 meter setup. As you go up in frequency the series capacitance drops. A good matched load on 432 MHz can be obtained as shown in Fig. 3. I sometimes remove the tin base from the bulbs, but this is not an absolute necessity. It is important to vary the amount of coupling, and thus the series capacity, by spacing the tab capacitor closer or further away from the ground plane, as detailed in Fig. 3. You also can use as many bulbs as you can solder onto a tuned rf inductor, even though they don't all light up with the same brilliance. You can match them all up, but you don't have to. Just check the wattage, or milliwattage, of each one and add them up for the total.

The number 48 or 49 bulb, listed at 2V and 60 mA, is rated at 120 mW, and glows dim at about 12 to 15 mW; so it can be used for low-power receiver oscillators, etc. With two other bulbs found in hardware stores, connected and matched to the rf inductor, such as the PR13 (5V at 500 mA), you can read correctly up to 5W. From there on up you're on your own, although a good variable 115V dc supply can be made up to work around 50 to 100W. I generally use a variety of 115V bulbs of different wattage, light them up with rf, and use their rated wattage.

. . . K1CLL ■

THE CONSOLE

Dee Logan WB2FBF
21 Judith Street
Nanuet NY 10954



Increasing station efficiency and enjoyment with a broadcast-style console.

Most hams go to great lengths to achieve peak operating efficiency from their station equipment, but seem to spend far less thought on station layouts that could also add to their operating efficiency and enjoyment. If you've been growing irritated with the teetering stacks of equipment and tangled snarls of cable that have resulted from random station growth, you may be ready to get organized via a station console.

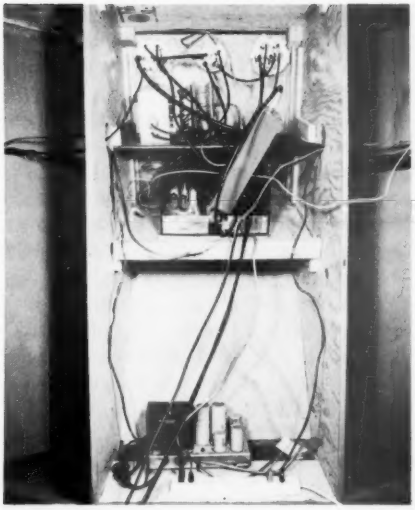
I formerly worked in commercial broadcasting as a combination engineer–announcer and realized from first-hand experience that it's possible to run an entire radio station from one operating position. The key is in the console that allows one man to control mikes, turntables, tape recorders and transmitter without leaving his chair. That's efficiency! Wouldn't that same approach be welcome in the hamshack?

Since most amateur radio stations have but one operator, the evolution of the console design can revolve around meeting his specific needs. It will, for example, mirror his operating habits, modes of operation, and personal tastes. The design for a serious DX'er will undoubtedly incorporate features that wouldn't be as important to the more relaxed, feet-on-the-desk ragchewer.

It might be pointed out that any design should result in a dramatic transition of your station from a random collection of individual components into a smoothly functioning system.

Once priorities are established, the evolution of a console system should follow some "noodling" with pencil and paper. Use a little "human engineering." This is loosely defined as calculating the optimum position, size, and motion of switches, knobs, and controls to achieve the most efficient operation with minimum fatigue (or frustration!). This may extend to such subtle points as the color scheme (light colors in greens, blues, and grays are more restful backgrounds).

The station console at WB2FBF evolved after researching what others had done, including K2YIH, who described a similar console in **73** back in November of 1963. Admittedly, a tour of NASA's Manned Spacecraft Center in Houston did a lot to start my dreams about what the station *could* become with the proverbial elbow grease, in lieu of an astronautical budget!



Behind the console panels, neatness doesn't matter quite so much. Large holes in the plywood cabinet sides facilitate cable routing; coaxial switches help to keep transmission lines out of sight.

Basic Design

The U shape of the console is actually formed by three wheeled sections that are held together by a bolted-on operating tabletop, hinged braces in the back, and five-sided top pieces that fill the spaces between the center section and each end. A pair of triangular pieces of Masonite are used in front.

The entire console, when broken apart, is narrow enough to roll through our basement door. Also, the wheels allow the operator to roll the complete unit away from the wall for easy access to the rear. Equipment is arranged in custom-cut panels that slope away from the operator about 6 in. at the top.

The arrangement utilizes the center section for the main operating area, and consequently includes the transceiver, swr bridge, antenna coupler, and an antenna network of coaxial switches. It's possible to quickly switch from dummy load to any of several antennas or to switch in a scope or antenna tuner as needed. The left panel contains the VHF area: Twoer, converter,

When the console bays are placed together, there will be large space gaps unless you build special-shaped wood sections like these. They add a professional touch and lend a look of uniformity to the three cabinets.

rotor control, and SX-111 receiver. On the right is an all-band receiver, ac line monitor and scope (added since the photograph was taken).

Lower portions of the end sections are used for storage of power supplies. Hinged front panels are used as baffles for speakers. The lower part of the center section is left partially open to supply legroom by running a Masonite piece diagonally down to the rear.

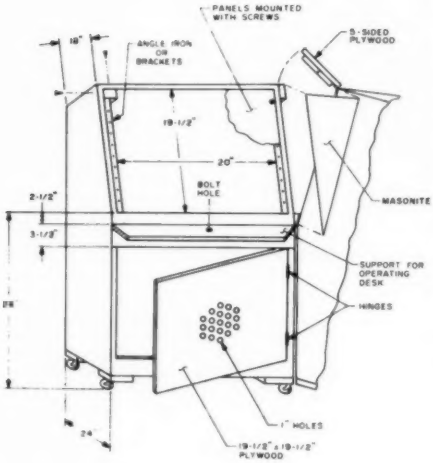


Fig. 1. Sketch shows general construction data for each console bay. Three of these bays form the operating console.

The console sections (Fig. 1) are each 20 in. wide (inner measure). This is an arbitrary dimension and is based upon accommodating the widest piece of equipment: our SX-111 receiver. The console is 48 in. high measured from the floor, with about 3 in. used for the hard rubber wheels that are mounted on pine squares on each corner. The operating desk provides a 12 in. deep writing surface, and is positioned 30 in. above the floor. Each console section is 24 in. deep, but is 6 in. less at the top due to the diagonal slope required for the panels.

Construction

Plywood, pine, and Masonite are the prime materials used in the construction. Interior-grade 0.5 in. plywood is used to form the three main sections. Two wafers of plywood form the sides; pine pieces are used at the bottom and front, held to the plywood by countersunk screws and glue. Use wood filler to cover the screws and sand smooth.

The top of each section is made of a plywood square, with reinforcement under each corner supplied by blocks cut from 2-by-4's. Use plenty of glue, wood screws, and cover the screw heads with filler. A bottom shelf is likewise made from plywood or Masonite.

One detail worth noting is the support for the operating desk. This is formed by making a narrow ledge about 3 or 4 in. deep out of plywood and sandwiching it between the pine pieces across the front of each section. The ledge should be about 27 in. up from the bottom so that when the wheels are added, the total height will be 30 in. above the floor. Be careful not to run this ledge the full width of the section; and cut the ends diagonally since it will be turned on an angle when joined with the other sections. The operating desk is added later and rests on the three ledges, attached by three countersunk stove bolts (one for each section of the console) and wing nuts.

Before mounting the speaker baffle panels on the bottom of the two end sections, drill a series of 1 in. holes in a pattern appropriate for the speaker sizes. Be careful not to splinter the plywood when drilling, and remember to cut into the finished side slowly. I used a circular saw and experiment on a piece of scrap beforehand.

After completion of the three sections, the general shape of the console can be arranged by pulling the individual sections together. The angle decided upon for our console was about 120 degrees between the center section and each end. Locking the center section to each end is done via hinged slats at the bottom rear, and a "trailer hitch" type of overlapping block near the front. Once the three sections are locked in place, measurements can be made for the five-sided plywood pieces that fill in the top and the pair of Masonite triangles for the front.

One thing confronting me in respect to finishing the plywood edges was in locating 0.5 in. wood strips at our local lumber yard. Since I lacked adequate power tools to cut the strips at home, some filler was called for. Cellulose-type filler goes on easily, but is difficult to sand down, so I opted for water putty. This is a powder

The desktop mounts neatly right over the support joists, locking the cabinets into a single three-bay console.

compound that can be mixed with water to produce a paste that can be applied to the plywood edges with a putty knife. When dry, it sands down easily.

Equipment Panels

Mounting equipment in a console of this type suggests at first glance that everything is virtually locked in for the future, but such isn't the case. Unless a console is flexible enough to allow for changes, it will eventually grow obsolete.

I selected easily cut 0.25 in. plywood and Masonite as the material for the panels, though aluminum sheet would provide a suitable surface if direct mounting of equipment on a panel is chosen. A series of shelves is arranged behind the panels and the equipment rests on these with the front protruding through openings cut to size in each panel. I made paper templates of the equipment and scored the panels with a pencil before cutting.

To mount the equipment panels in the console, angle iron with tapped holes would be ideal. Lacking that, I used wood strips surfaced with scrap chrome. This allows the panels to be mounted with either metal or wood screws.

Operating Desk

Since the operating desk (Fig. 2) must fit snugly against the main console, it shouldn't be started until the console itself is completed. To insure a good fit, make a template from cardboard or stiff paper before putting saw to wood. Plywood forms the surface of the desk and angled end supports, but I used pine for edging.

Once the desk is finished and in position, drill three holes – one on each edge near the console – through the desk and down through the supporting ledge. Add stove bolts, countersink, fill, and sand smooth.

One feature of the console that adds the "commercial look," is the Textolite plastic laminate used on the desk surface. The color was selected to match that of the main console, and provides color "coordination." Alternate materials would suffice, such as cutting up an old dinette table's Formica top. There's also the old standby of linoleum or asphalt tile.

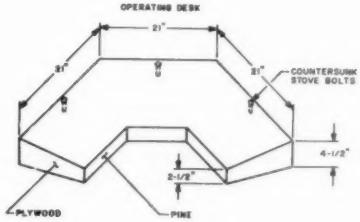


Fig. 2. The tabletop is inclined slightly for operator convenience. The design shown here was used in the author's console, but individual preferences may dictate slight differences in layout, slant, etc.

Finishing Touches

Since plywood is a thirsty material and rather grainy, take time to sand the entire unit well and then apply a good primer. Use good-quality high-gloss enamel for the finish and apply several coats. Allow for a

bit of extra paint to keep on hand for touchup later.

Panels holding the equipment are painted battleship gray, which is a standard medium color that "wears well." This contrasts with the light bluegreen used on the main console and operating desk. Gray blends with most pieces of commercial gear.

Labeling was done with "burnish-on" instant lettering dry transfers. A Datakoat protective coating will keep the letters permanently in place. The use of rub-on lettering does add quite a professional touch to the final product.

Electrical

The possibilities of designing various wiring networks for antennas, ac, audio, and accessories are virtually endless, and depend upon the station equipment to a great degree. I devoted my attention to the rf switching network—including the antenna switching system. A very complete discussion of the electrical aspects of console design was in 73 January 1969, and since W6GDP detailed it well, there is little need to cover it again.

One point might be covered, however: the use of commercial coaxial antenna switches provides efficiency and convenience over the alternate method of manual switchboard-type patching. It's one of the main selling points of any console to be able to eliminate the old juggling act of manually changing antenna coax when switching bands. My antenna network includes three coaxial switches (grounded, by the way) that allow selection of several antennas or dummy load, switching in or out the antenna coupler or monitor scope, and directing the antenna to several possible transmitters or receivers.

Piece de Resistance

A flexible microphone boom was added to the console (a "Flexo Mikester") and thus clears the operating desk of one more piece of gear. Audio cable is run to the transceiver through the rear, and since the TR3 has side-mounted jacks for phones and key, these were disabled and bypassed to standard jacks mounted on the console panel. A push-to-talk switch is likewise mounted outboard of the transceiver.

After a shakedown period, the cables and associated wiring inside the console should be secured with cable clamps. Cable runs between console sections are via holes cut in the middle of the interior walls. A hefty ground bus should be installed in each section.

One last note about keeping the desk clear of accessories: remember that there's plenty of room to mount small black boxes under the desk or in the storage area behind the speaker baffles. I had a surplus audio filter that was a "must use" with the transceiver and found that it could be neatly tucked away under the operating desk with four screws. I keep headphones out of the way when not in use by hanging them under the desk on a couple of hooks.

Removal of the tabletop and triangular "gap fillers" permits easy disassembly of the station for removal and transport. Note the "trailer hitch" connection between sections at lower right.

A good coat of paste wax on the finished unit will wrap up the job. Then you can sit down and enjoy a new dimension to hamming with everything under control and at your fingertips!

. . .WB2FBF ■

Sam Creason K6DQB/9
941 Beau Drive
Des Plaines IL 60016

AN IMPEDANCE MULTIPLIER FOR THE VOM

A voltohmmeter or similar device can be found in almost every shack. The typical VOM is inexpensive, rugged, and independent of the ac mains. However, it has a disadvantage in that it can't be used to measure voltages in relatively high-impedance circuits without some loss in accuracy. Consider the circuit in Fig. 1. A VOM is being used to measure the voltage drop across R2. A typical VOM has an input impedance of 20 kΩ/V (or less). This means that the input impedance of the VOM, in ohms, is 20,000 times the full-scale voltage.

On the 10V scale, for example, the input impedance is 200 kΩ. If R1 and R2 are relatively small, say 2 kΩ, then the effect of shunting R2 with the VOM will be small. In Fig. 1, if the applied voltage is 20V, then the VOM will read approximately 9.9V. On the other hand, if R1 and R2 are 2 MΩ, then the VOM will read approximately 2V! Clearly, one solution to the problem is to buy a VTVM with an input impedance of 22 MΩ or so. A less expensive solution is to build the impedance multiplier described in this article.

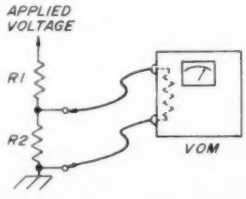


Fig. 1. Circuit under test by VOM.

The schematic of the unit, shown in Fig. 2, consists of a voltage divider which presents a 25 MΩ impedance to the voltage being measured, and an operational-amplifier unity-gain voltage follower.

The voltage follower has characteristics which make it ideal for the task at hand. Its input impedance is of the order of several hundred megohms so that it does not degrade the accuracy of the voltage divider. Its output impedance is less than an ohm and it can supply up to 5 mA (or more, depending on the amplifier used), so is virtually unaffected by the VOM. Finally, as its name implies, its output voltage is (for all practical purposes) the same as its input voltage.

For the ham who is looking at his first operational amplifier circuit, the following may be helpful.

An operational amplifier is a linear, high-gain, direct-coupled amplifier, usually provided with a differential input, but with its output referenced to ground. The usual symbol is shown in Fig. 3a. If a small voltage (a millivolt or more) is applied, the output voltage will swing to one or the other of its limits (typically ±10V). Only for voltages less than about 0.1 mV (for the ZEL-1) will the output voltage not be at one of its limits.

The polarity of the output voltage depends directly on the polarity of the

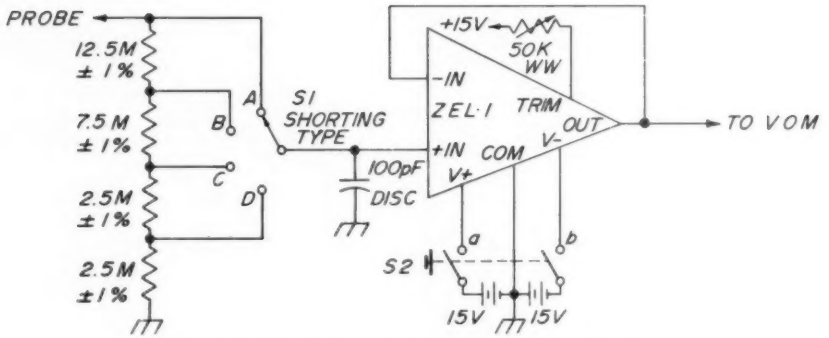


Fig. 2. Schematic diagram of the impedance multiplier.

input voltage. That is, with the positive lead of the source connected to the positive input of the amplifier, the output voltage will be positive, and vice versa. Further, instead of connecting one voltage source across both input terminals, a separate source can be connected to each input, with the second lead of each source connected to ground. In this case it is the difference of the two input voltages which appears across the amplifier input. The key to the operation of the follower is that one of these voltages is the one we wish to measure while the other is provided by the amplifier.

A simplified schematic of the voltage follower is shown in Fig. 3b. Consider what happens if, say, +5V is applied at E_{in}. If E_{out} happens to be at some value other than very nearly +5V when the input voltage is applied, then a large voltage appears across the amplifier input and the amplifier is driven hard toward one of its limits. But as the output swings past +5V, as it must because of the polarity relationships enumerated above, the polarity of the input signal is reversed, which means that E_{out} will then start to swing in the opposite direction. Because the gain of the amplifier is large and the response time short, the voltage difference across the input terminals is quickly driven to a very small value and the circuit obeys the relation:

$$E_{out} = E_{in}$$

The voltage follower is only one of a wide variety of operational amplifier circuits. The interested reader is referred to the publications listed in the bibliography.

The circuit of the voltage follower is well known and time proved. The author has constructed followers using various amplifiers in a variety of electrochemical instruments. For the ham who is starting from scratch, two amplifiers can be recommended. First is the ZEL-1, the type specified in Fig. 2, which is available for $11 from Zeltex, Inc., Concord, Calif. While the ZEL-1 is expensive, it does tend to be forgiving about having its output shorted to ground and the like. For the less cautious ham, the μA709 is available at $2 from Poly-Paks, Lynnfield, Mass. 01940. It is not nearly so forgiving. A circuit which accommodates the μA709 is shown in Fig. 4.

Other than the fixed-value components, the main difference in the circuit requirements of the two amplifiers is the 50 kΩ trim pot which is used with the ZEL-1. The pot is used to adjust the follower output to exactly zero when the probe to the voltage divider is shorted to ground. In some applications, the absence of such a control

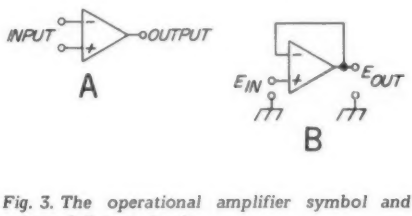


Fig. 3. The operational amplifier symbol and voltage follower circuit.

in the μA709 circuit would be a handicap. However, an error of only a millivolt or two is likely to result in this application. If a ZEL-1 amplifier is used, the pot may be replaced by a fixed resistor once the correct value has been experimentally determined.

to its 10V range, a full-scale range of 10, 20, 50, or 100V is provided when the range switch (S1) is in position A, B, C, or D, respectively. The unit may also be used with the VOM switched to a more sensitive range. As before, the voltage which appears at the output of the amplifier is the same

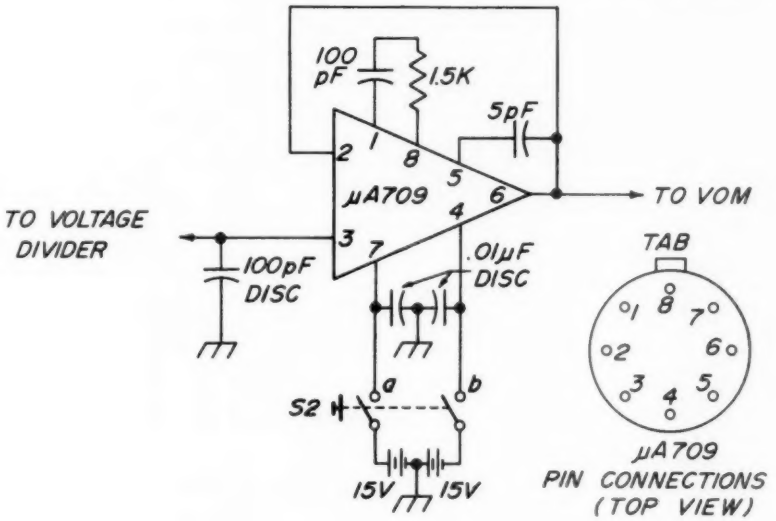


Fig. 4. Circuit modifications for μA709 amplifier.

The accuracy of readings made with the impedance multiplier in use will depend in part on the accuracy of the VOM involved and in part on the accuracy of the resistors used in the voltage divider. Since the garden-variety VOM has an accuracy of no better than ±2%, use of better than 1% tolerance resistors seems unwarranted.

A DPST switch should be provided as shown, in the interest of long battery life. Also, battery voltage should be checked frequently, since the output voltage swing capability of the amplifier depends markedly on supply voltage.

Physical layout is not at all important. The device will fit into a small minibox which can be provided with male plugs so that it can be plugged into the VOM in place of the probe leads.

Operation of the impedance multiplier is straightforward. With the VOM switched as that at the input of the amplifier, but the full-scale capability of the combination is reduced. For example, with the VOM switched to a 2V range and the voltage divider switched to position D, the voltage to be measured must be less than 20V or the VOM will go off scale.

The impedance multiplier may be used to make either dc or low frequency ac (audio) measurements. The only restriction is that not more than 10V may be applied to the input of the voltage follower.

Finally, I would like to thank Dr. Robert F. Nelson, in whose laboratory I first made the acquaintance of op-amps.

. . . K6DQB/9 ■

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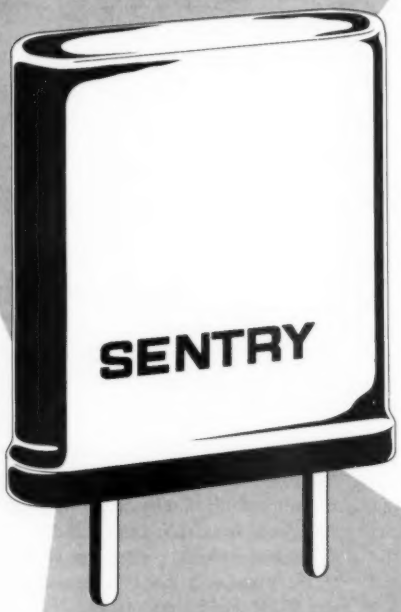

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REPEATER AUDIO:

TIME OUT FOR QUALITY

Use of a cathode follower to pick audio directly from the repeater's discriminator can do wonders for an ailing amateur relay system.

by Ken Sessions, Jr. K6MVH

Ask any FM'er to describe what he thinks is the most common problem in the world of repeaters. Chances are he'll say "desensitization." If he's a repeater owner, he'll probably tell you how he fought that isolation battle for days or weeks before he finally got the repeater transmitter and receiver percolating perfectly, 600 kHz apart, in the same building, using but one antenna, and with no noticeable receiver degradation.

But the fact that the problem was overcome, as it is in almost all heavily used repeaters, removes it from the "problem" category.

All right, then, if desensitization is not the most common repeater problem, what is? In my opinion, it's *audio* – rotten, garbagey, distorted, scrapey, overclipped, overlimited, asymmetrical re-pre-de-emphasized, lousy-sounding audio. And the reason bad audio is such a problem is that it just doesn't seem serious enough to warrant the extra engineering necessary to change it.

There's plenty of chances for repeater audio to go bad. First, there's the receiver: If the low i-f is out of adjustment, certain voice frequencies will distort and loud signals will squelch out of the receiver's audio passband. There's the chance for microphonic tubes, or improper de-emphasis circuitry.

Often, a repeater builder in a hurry to get a system going will connect the speaker leads of the receiver directly to the audio input of the transmitter. In doing so, he causes the receiver audio to be processed through so many circuits that degradation could take place even if by nothing more than the process of "diminishing returns."

Every stage loses something from input to output, and the slightest bit of distortion anywhere is immediately amplified and exaggerated in all subsequent stages. Consider the stages the audio must be cycled through faithfully: The repeater user speaks, and his microphone "transduces" the sonic waves into electrical signals. These signals are generated again in the output of the transmitter's af amplifier and phase modulator. The receiver processes the audio some more from the discriminator, through audio amplifiers, through the output transformer, and finally to the speaker, where the af is again "transduced" from electrical ac to air "pressure" waves. Considering what the audio must go through from one end of the system to the other, it is no wonder that some of our repeaters sound so bad.

All this doesn't come as any great surprise to most repeater owners. They know what's wrong and how to fix it. But sometimes they listen a little too subjectively to the product of their own handiwork. To them, it may just not sound bad enough to justify circuit modifications.

If you happen to know a repeater owner whose foot happens to fit the shoe of distortion, invite him to make the "comparison" test. At the repeater site, or near it, set up a two-channel receiver capable of monitoring the repeater input and output frequencies. This receiver must have the same bandpass limiting characteristics as the repeater receiver. Then, get someone to transmit a 1 kHz tone (at the receiver's maximum deviation-acceptance level) on the repeater input frequency. Switch the receiver quickly from the repeater input to the output. If the signal sounds cleaner on the input frequency than it does on the output, it's time to reroute some of the audio at the repeater.

There are a number of places where you can pick off audio on a receiver, but none will give a signal quite as "virgin" as the discriminator. If high-fidelity audio was transmitted, you'll be able to reclaim high-fidelity audio if you get it before it gets past the discriminator.

But getting audio from the discriminator presents other problems. For one thing, the discriminator "sees" the audio before the squelch does. Which means that every time the transmitter is keyed without the presence of a quieting signal, a bothersome "squelch noise" will be transmitted. (Phone patch operation is one such case; on-site operation of the repeater transmitter is another.)

Another problem is impedance matching. The discriminator represents an extremely high impedance audio load. The transmitter audio input is apt to be quite low by comparison, particularly if input level adjustments are to be made.

Still, there is no better signal source than the discriminator, if high-quality audio is to be a criterion. And the problems aren't problems when there's a simple solution.

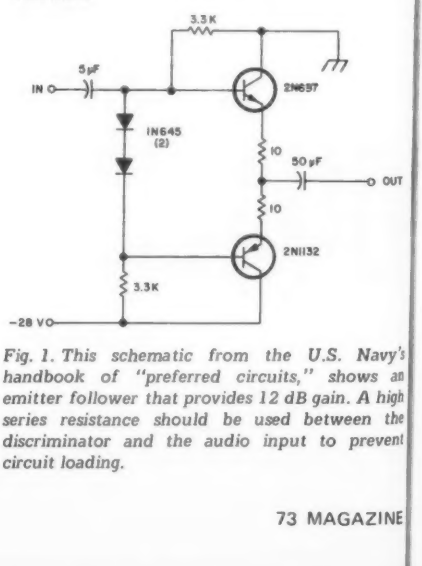


Fig. 1. This schematic from the U.S. Navy's handbook of "preferred circuits," shows an emitter follower that provides 12 dB gain. A high series resistance should be used between the discriminator and the audio input to prevent circuit loading.

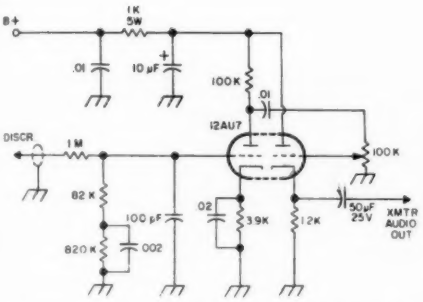


Fig. 2. This 12AU7 cathode follower is similar to the type used in commercial GE repeaters. As shown, the B+ plate supply is stabilized with a 1 kΩ resistor and filter capacitor.

Use of a cathode follower solves most of the problems. It provides excellent circuit isolation, matches a very wide range of impedances, and allows control of audio level without upsetting the receiver or transmitter audio adjustments. As a bonus, it allows completely independent local control of the repeater receiver's audio gain.

The remaining "problem" is that of discriminator "squelch" noise being transmitted when the rig is keyed without a carrier. This is solved by routing the cathode follower output to ground during all no-signal periods. The normally closed COR contacts work great for this.

The transistor equivalent of a cathode follower is the emitter follower, which will do anything a tube can do. The circuit in Fig. 1 shows an emitter-follower audio circuit that should prove ideal for repeaters with 28V dc control. (I always use −28V for repeater control because of the availability and economy of surplus 24–28V relays, and because the −28V power source can double as a transmitter bias supply.)

If no dc control voltage source is available, however, the cathode follower will probably prove more valuable. The circuit shown in Fig. 2 uses a dual triode to give one stage of amplification to the audio signal. This circuit is basically the type once used by General Electric Company in its commercially manufactured repeaters.

A well-bypassed high value series resistor, on the order of 200 kΩ, should be used between the discriminator and the cathode follower for maximum isolation and to prevent circuit "loading." In most cases the audio can be picked right off the discriminator test point, but the audio lead should be shielded to prevent pickup and processing of stray noise and audio "garbage."

The carrier-operated relay, if connected as shown in Fig. 3, does double duty by killing the receiver audio completely except when a carrier appears on the input. In this way, the repeater transmitter can be used by an on-site operator without his having to compete with squelch noise. The diode in the push-to-talk lead will prevent the COR from being triggered when the transmitter is keyed directly, and the 47K resistor provides isolation between the local mike and the audio circuit ground.

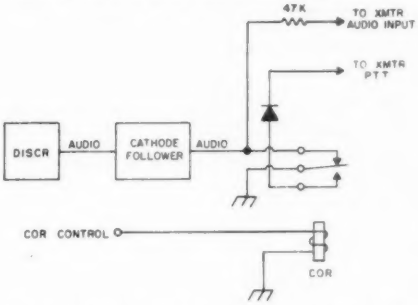


Fig. 3. The basic COR should be used to ground the receiver audio when no signals are on the input. The resistor in the audio line provides sufficient isolation so that a local mike can be used even though the audio line is grounded.

A Final Word About Quality

Repeater "listening conditions" aren't getting any better. More and more handie-talkie units are being used with repeaters, and repeater users are operating from such way-out noise sources as motorcycles, boats, skimobiles, and planes. As time goes by, repeater owners will find that effective audio will be a consideration surpassing "coverage" in importance. For after all, what good is a broad range of coverage when you can't make out the intelligence on the repeater output? But good audio *can* be built into the system. It's only a matter of taking a little extra time and putting in just a smidgen more effort.

. . . K6MVH ■

ATV GETTING A BETTER PICTURE

Serge Miller WA6BJV
1914 Caddington Drive
San Pedro CA 90732

The amateur television hobby is spreading in many areas; it is interesting, challenging, and educational. Receiving these signals does not require a large outlay of money or a major constuction project; it does involve a certain amount of work and thought, since there is no appliance on the market ready for immediate use.

Amateur television transmission (A5) is authorized in the 420 to 450 MHz amateur band. In Southern California, AM (A3) stations operate on 432 (±0.5) MHz, ATV stations occupy the spectrum from 433 to 440 MHz and FM'ers use the frequencies between 440 and 450 MHz for repeater control and remote operation of lower frequency base stations.

As can be seen in Fig. 1, a typical ATV receiving station consists of a homebrew antenna, a transformer, a transmission line, a preamplifier, a UHF converter, and a TV set.

Antennas

A broadband directional antenna with a low swr and a relatively high gain (10 dB or more) is a must. A flat response of 8 MHz is necessary since TV signals are several megahertz (±4.5 MHz each side of carrier) wide and not every station operates on the same frequency. Yagis are not broadbanded devices unless the length of the elements are tapered, decreasing the gain. Collinears, skeleton slots, and log periodics meet the broadband and gain requirements. Groundplanes and similar omnidirectional antennas are satisfactory for general band monitoring but are susceptible to multi-

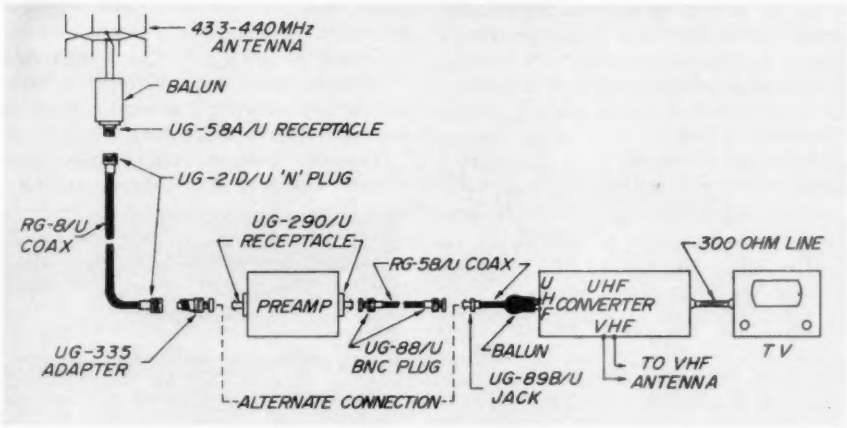


Fig. 1. Typical ATV receiving station.

path distortion and ghosts. An swr of less than 2:1 means that the antenna is matched to the transmission line and all energy is transferred efficiently. If an antenna system with a high swr is used for transmission, "ghosts" will be radiated and antenna reorientation will not solve the problem.

Most of the commercially available antennas for the ¾ meter band have turned out to be complete flops at antenna gain measuring contests. A popular brand of ¾ meter collinears has been proved totally unsatisfactory on numerous occasions due to improper match to the transmission line, incorrect resonant frequency (anywhere from 450 to 500 MHz), and short matching stubs.

A reliable workhorse in this area is the 16 element collinear shown in Fig. 2. Standing wave ratio is under 2:1 from 432 to 439 MHz, and gain is 12 dB above dipole. Check the polarization used in your area (probably vertical) and mount accordingly. Cross polarization can introduce as much as 20 dB loss, reducing the signal by two orders of magnitude!

Baluns

The antenna shown in Fig. 2 has a feedpoint impedance of 300Ω balanced. Since coaxial cable (unbalanced) is recommended, a device that will transform the impedance and convert from balanced to unbalanced must be used. Figure 3 shows two types of baluns for the ¾ meter band. The coaxial sleeve type is more difficult to

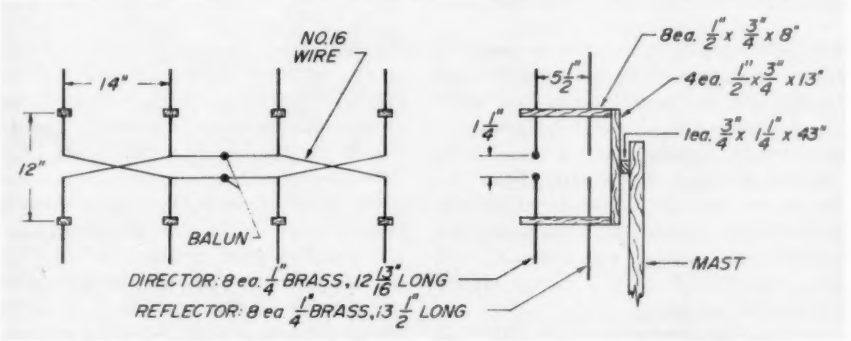


Fig. 2. 16-element collinear antenna for 432 to 440 MHz; 12 dB gain above dipole.

build, but it is more efficient and provides a better impedance match. If the antenna system is used for transmission, the coaxial line balun should definitely not be used.

Transmission Lines

Some people blindly state that coaxial cable is not good at UHF frequencies due to high signal loss and that the only transmission line to use is parallel line.

The only time twinlead or open transmission line will perform per specification is under laboratory conditions where the line is kept away from roofs and gutters, masts and rotors, walls and windows, and the humidity is 0%; anything in the vicinity of the parallel line affects its performance. In a dry lab, tubular twin lead has 3.1 dB loss per 100 feet at 500 MHz. When the line is wet the loss jumps up to 6.8 dB. Coaxial cable can be run anywhere under vitually any weather condition. At 450 MHz new RG-8/U cable typically has 4.6 dB loss per 100 feet.

If your antenna system has 50 ft of tubular transmission line, run under ideal conditions, you will gain 1 dB of signal over coax cable and you will never see the difference on a TV set! (Yes, I know that open transmission line is better than tubular, but try to work it around a rotor or wait until several birds collide with it.)

Foamed dielectric coax cables have slightly less loss than conventional RG cables, but do not always mate properly with "N" type connectors due to an oversized center conductor. This type of cable is labeled "8/U TYPE" or "foam RG-8 type" instead of RG-8/U.

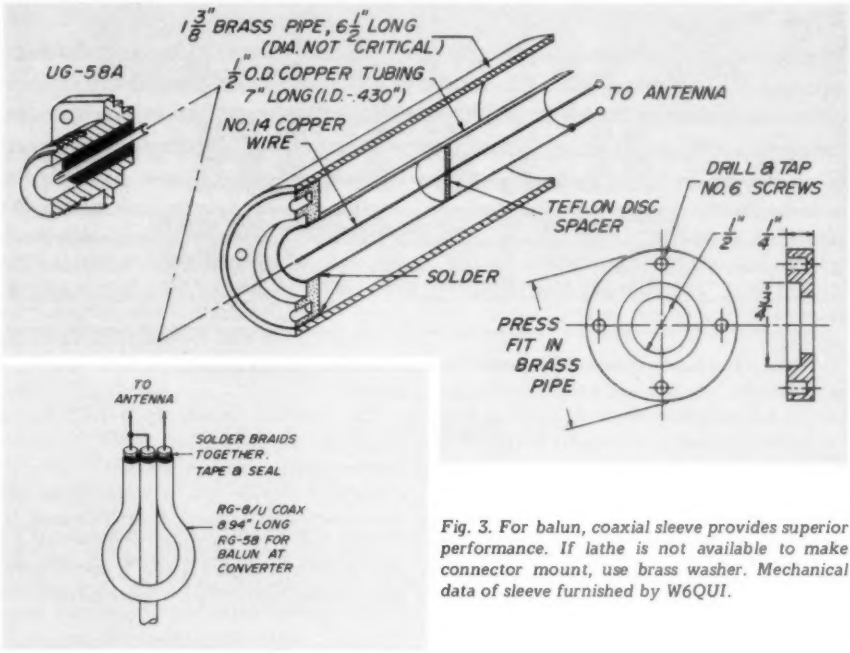


Fig. 3. For balun, coaxial sleeve provides superior performance. If lathe is not available to make connector mount, use brass washer. Mechanical data of sleeve furnished by W6QUI.

Preamplifiers

The effective radiated power of commercial UHF TV stations can reach in the megawatt category; amateur stations seldom exceed one thousand watts ERP. UHF converters have a conversion loss and noisy mixers. Even converters with amplifiers do not cure the noise problems, since the amplifier stage operates at the VHF frequencies after mixing; the converter referred to in the next section has a conversion loss of 6 dB. From the previous facts you can see that a low noise FET

preamplifier with at least 10 dB gain is mandatory when receiving all but local stations. Field-effect transistors (FETs) are superior to bipolar transistors due to better noise figure and less susceptibility to cross modulation.

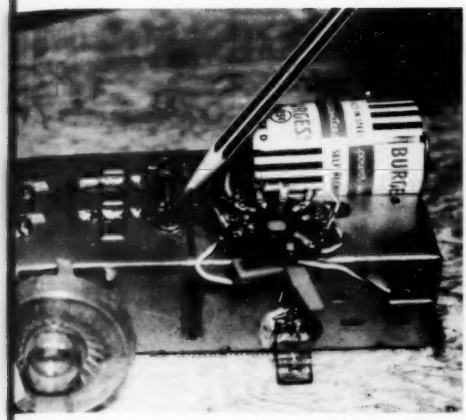
Set Modification

The picture carrier frequency of channel 14 is at 471.25 MHz; the picture carriers in the ¾ meter band are close to 435.25 MHz, 36 MHz below the low-end limit of UHF converters. Television sets with built-in converters are not easily modified to receive ATV signals since the conversion project requires the addition of extra components within the unit, and each manufacturer has its own peculiar circuit.

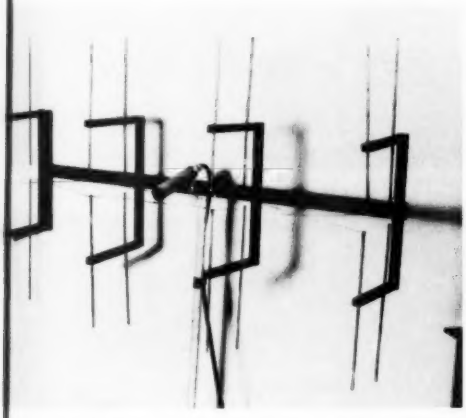
A popular UHF converter in this area is the battery operated Blonder-Tongue Ultraverter, Model BTD-44. The battery lasts 6 months and keeps the cost down; and modification is simple.

When the UHF converter is hooked up per manufacturer's instructions, proceed with the following modifications:

1) Turn TV set to channel 6 (or 5 if 6 used in your area), place converter slide switch to UHF and tune in a moderately strong station between channel 20 and 30 (28 for example).
2) Remove dial, slide converter out of case, then reinstall dial so that number of tuned channel is lined up with top of converter.
3) Rotate TV set channel selector from channel 6 to channel 3 (or 2) slowly. Every time channel selector is moved one channel, retune converter for picture of channel 28.
4) With channel selector on channel 3 (or 2), peak two alignment screws on top of converter for maximum picture. Converter is now detuned 22 MHz and dial should indicate 4 channels higher than station being received.
5) Rotate converter dial 1/8 in. counterclockwise. Turn alignment screws clockwise about 1 turn each for best picture. Repeat operations until picture of channel 28 appears at a dial reading of channel 34 (or 6



Alignment screw of BTD-44 UHF converter.



16-element collinear antenna after 2 years of service.

channels higher than station used as signal source). The converter is now detuned 36 MHz below indicated channel.

6) Turn converter dial to indicate channel 14. The converter now receives 435.25 MHz (471.25–36 = 435.25).
7) Disconnect UHF antenna from converter and connect balun made of RG-58/U cable as shown in Fig. 1 and 3 to UHF input of converter. Connect ¾ meter antenna to balun. This is necessary since broadcast UHF antennas are not efficient on ¾ meter and are horizontally polarized.
8) Modulation bars on the third harmonic of your 2 meter transmitter should be visible on TV set.
9) Arrange with a local ATV station for a signal to be transmitted in your direction. When picture is tuned in, peak the two alignment screws for best picture.
10) Reinstall converter in case and tune in channel 28. Mount dial to indicate channel 28 below marker.
11) Tune in local ATV station and mark dial under marker.

TV Set

Older TV sets can be purchased for as low as $5 from stores who do a large volume of trade-in business. Insist that set be turned on for operation before buying. Do not get involved with sets that have series filaments such as portables; they are more difficult to repair in case of failure and may have a hot chassis. The sound section should also be operational since many ATV stations are transmitting sound in conjunction with video.

When the set is used primarily for ATV operation, shrink picture horizontally and vertically a little bit to give received stations better signal evaluation.

Conclusion

With the equipment described above, I have received ATV stations from all parts of Southern California, some from the other side of mountains and others as far as 110 miles away. Now it's your turn.

. . . WA6BJV ■

ATV signal received with: (a) groundplane antenna

(b) 16 element collinear antenna

(c) collinear and preamplifier

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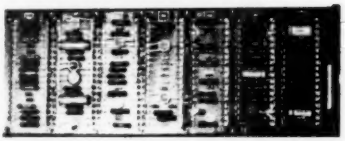

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THAT CONTEST CRAZE

An old tiger bares his fangs.

I've been in there pitchin' in contests for years – but each attempt to turn in a really big score has been abortive. Some unforeseen hitch – domestic, social, or business – has always come up.

This time – yes, I said *this time*, I was all set to pile up a mighty total. Lady Luck was going to be with me this weekend. I simply felt it, and what better companion to have on one's arm – especially the code arm.

Nothing had been left to chance. I had hired a spare transmitter and receiver, in case my anticipated 48 hours solo nonstop proved to be too much for my tired pile of junk. I climbed the tower and double-checked the beam. Sent the kids off to Gran and Gramp's for the coming few days. Tranquilized the dog in the hope it would sleep more than bark. I told the wife the house *had to remain quiet* – no parties, no engagements.

It was dark on Friday evening before I made it home from work.

"Supper ready?" I asked Helen.

She looked surprised. "Not quite. What, no stopover at the pub with the boys?"

I patted her gently where she's most comfortable. "Nope, it's into bed right after I eat. Say, are those sleeping pills still in the cabinet?"

"Yes, but aren't you making a big thing of this contest?" She eyed me suspiciously.

"Maybe, Honey, but I've got to win this one. Competition's tougher each year. Lots of young bloods coming on."

"How will you pace your fading physique against a determined 20-year-old, in a two-day scrap?"

I put on a smirk. "Guile; it's an old dog for a hard road."

My wife looked skeptical. "You're an old dog, right enough, but a 30-year handicap. . ."

Sweet anticipation won't be turned bitter. This was to be *my* weekend and *my* contest. Even my horoscope said so. I was about to nudge the contest Greats. Write my name in ham history.

Deciding to recheck the rig before I turned in, I drifted into the shack. The band was wide open. And tomorrow, I'd be right in there with the best of 'em. An unfamiliar call came through the din. . .it was a pileup, calling on 8F3! Maybe I could just give a quick call before bedtime. . .

At 9:30 p.m., two and a half hours later, Helen tapped me on the shoulder.

"You're in a contest in the morning – remember? Or do you plan to work straight through?"

Piqued and smothering a testy reply, I rose and switched off the rig, letting the 8F3 die still unbagged under the pileup.

From the bathroom I called, "Honey, whereabouts in the cabinet are those pills? I'm hitting the hay."

"Left side, top shelf," she called back. "Small white box. There's a couple loose alongside."

"Ah, yes," I said, groping. I downed one without water.

"Ugh – what a taste. Say, do you take many of these?"

Helen poked her head through the open door. "A few. Why?"

"They're foul."

"It's your taste buds. I find them a little chalky but quite mild."

Somehow Morpheus ignored my closed eyes. Why on this night above all should the gods choose to pass me up. Drowsiness would not come and the lousy taste in my mouth persisted.

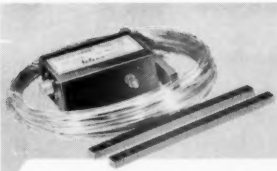
"Isn't it maddening," I said to myself, but loud enough to be overheard. "Sleep is like a coquettish woman. Woo her and she withdraws her charms."

Helen made the sounds of a person whose sleep had been disturbed.

"That pill didn't do any good; and I can still taste it," I said.

Helen rolled out of bed, stumbled over to the bathroom, and I heard her rummaging in the cabinet. Finally, she appeared with a glass of water, another pill, and a small sardonic smile playing at her lips.

"What's this – another one? Is it okay to take a second one?"



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"Swallow it," she ordered.

It tasted different. "What is it?" I asked.

"A sleeping tablet. That other pill was a distemper mixture for the dog."

"A what?" I sat up incensed. "That bloody animal has more status around here than the kids and I have. Even his medication is mixed up with ours. Is it poisonous?"

You'll be okay," she said. "Just try and doze off."

But instead of sweet dreams in the head, I developed cramps in the midriff.

"Honey," I called again after a while. "What's the time?"

"I'll bring you the alarm clock," came Helen's voice, now slightly irritated. "You can time yourself. What's up now?"

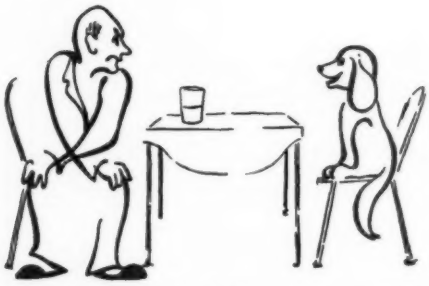
"Can't sleep and I'm queasy. Feels like indigestion or something. "Is Jack home?" (Jack is a doctor friend of ours who lives a few houses away.)

Helen parted the drapes and peered out. "Yes, there's a light on."

I tumbled out of bed to the phone and dialed.

Dr. Jack arrived; when I told him the story, he superficially looked me over and then inspected the box of dog medicine. He began to guffaw loudly.

"This prescription contains among other things a strong deworming purgative. That's what's making you ill." For some reason, he found the whole episode quite hilarious.



When he regained his composure, Jack said, "That compound is pretty rough on the intestinal tract, but it'll probably do an old dog like you more good than harm. Just ignore the discomfort and the cramps. They'll pass." Then he was gone.

Miserably, I contemplated the ceiling above the bed. With my big moment coming up, I had to go and deworm myself. A heavy slackness was taking hold of my limbs. The pill was working.

Somewhere, very faintly at first, as if at the end of a long corridor, a telephone was ringing. Not all the time, for there seemed to be breaks, but it persisted. Slowly I became aware that someone was moving near me. Helen was pulling on a dressing gown. She reappeared a moment later and threw on the light. Dazed and stupid I slowly became more conscious under its glare.

"Wassamatter, wassatime?" Even through my sophoric, phenobarbital haze I could see urgency written all over Helen's face.

"It's 3 a.m. – the fire brigade's calling you."

"Who?"

"You – go and see."

With great effort I managed to get myself slowly upright and groped for the phone.

"Is that Mr. Shawsmith? Do you have a Real Estate office in 'Gabba Lane?" I nodded, oblivious to the fact that my caller wouldn't notice.

"There's a fire in the building adjoining your business. We must ask you to come immediately."

I was so doped it hardly registered. "There's a fire. . .?"

"Yes, sir; your office is in danger."

I dropped the handpiece, unable for the moment to do more.

"Honey," I said weakly, "Will you drive, I don't feel up to it?"

The glow in the sky was plainly visible.

At the conflagration the usual scene prevailed. Confusion, bedlam, and noise. We parked the car at the nearest possible spot and made down the lane.

"Helen," I shouted. "You grab the typewriters and take 'em across the road. I'll get some help with the safe." We made two or three sorties and removed most of the important papers and files before the heat became too intense. Water now began to pour through the ceiling and it was obvious nothing more could be done. We

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stood for a while and then retraced our steps to the car only to find a young police constable, notebook in hand, pencil poised.

"This your vehicle?"

"Yes." Meekly, weakly, I answered.

"It's illegally parked."

"So are one hundred others." I swept an arm to indicate the traffic jam.

"I shall have to book you."

"It was an emergency," Helen explained. "We had just been rescuing our belongings from the blaze."

Unmoved, the cop started writing.

"You will receive a summons, but there is no need to attend court; you can simply pay the fine at. . ."

Is there anyone more infuriating than a pedantic flatfoot?

"Look," I said testily. "I don't want any instructions as regards my lawful rights. I'm more aware of them than you are. You'd do better down there helping the men." I pointed to the fire.

Helen kicked my shin. "Ssh," she whispered. "You'll finish up in the van, and that means bail money or no contest this weekend." The cop tore off the ticket and handed me a copy.

It was daylight before we slid into bed.

Hardly more than a wink went by before Helen shook me awake.

"Sixty minutes to blastoff," she said. "Thought you'd want time to snack and shower."

I lay like a slack sack. Where was my fitness of days before? Gone in the loss of a night's sleep. Dismally I contemplated the status quo. Ahead was 48 hours of bedlam and intense concentration and

already I had a pounding head. My office in ruins and a parking fine from a pin-headed cop. I cursed the fates: definitely a favorable weekend my horoscope had read.

Somehow Helen's freshness and energy provoked irritation. How could anyone be so full of bounce after such a sleepless night?

"So you're a quitter," she said. "Stop feeling sorry for yourself. A little passing 'grippe' won't kill you." My DX contest capering brings out a certain bitchiness in the old girl. It's the old love/hate complex and I still don't know after all this time if it is directed at me or to amateur radio generally. Anyway, how can a man come to terms with a woman who roots for her OM to win and at the same time disapproves of what he's doing. There's female ambivalence for you.

With a single movement she swept the covers off the bed.

"Come on," she urged. "Take a shower."

I fronted the bathroom mirror and recoiled. Helen's face appeared behind mine. "Hm, now you re vertical you do look rather ghastly. Guess you could use a little health and strength. "How about a prayer to St. Ionos. Isn't he your. . .?"

"Wrong saint," I said. "His portfolio is DX communication."

Then suddenly I remembered. "Say, Honey, there were a couple of pep pills in an old brown envelope. Are they still. . ."

"Al, if you take *just one* of those, you can have the house to yourself for the weekend. Fools never learn."

I dragged my tired torso off to the shack and switched on the rig. As the receiver came to life a sheaf of contest forms was shoved under my nose.

"Sign these before you get under way. Last time it was a case of 'love's labor lost'; you forgot to add your signature and were disqualified."

Again I obediently did as I was bid.

Only to a contest competitor is the cacaphony of CW actually music. However, as time wears on this sweetness turns to a painful drumming in the head. The ears become more and more sensitive by the hour, until too much of a good thing turns to sheer torture. So the race dragged on. The halfway mark came and went and the pace more difficult to sustain. It was supper time on the second evening that my wife found me, like a warrior, down but still clutching the flag, sprawled asleep at the rig. Phones on head and hand on key but beaten by fatigue and age. Twelve hours short of target.

I was hauled to a divan, divested of my slippers. As Helen threw a blanket over my somnolent form, she claims I mumbled a short philosophic comment, aimed as a barb at that Yankee poet who gave us the line, "I am master of my fate." Bah! we're just flimsy straws in the windy turbulence of existence.

Epilog

One day some months later I arrived home to find Helen jumping up and down excitedly and waving a large envelope.

"Al, I knew what this was so I opened it. Couldn't wait; hope you don't mind. It's your contest award."

I read. "VK4SS OCEANIA CONTEST WINNER. Place in Top Ten W.W. No 7." "But, hey, I never sent in a log for this."

"But I did."

"You mean you wrote out my whole log. But I didn't finish the course – remember.'"

"How could we forget; you were so piqued you went QRT for a month, but I heard on the grapevine that the bands were put out by a bad solar storm several hours before the big scrap ended; so I decided you had a chance after all."

What do you say to a wife who's so smart it hurts?

. . . VK4SS ■

LOG PERIODIC

ANTENNA DESIGNS FOR UHF/VHF

William L. Nagle W3DUQ
RD-1 Box 188A
Honeybrook PA 19344

The log periodic antenna was originally designed and proved at the University of Illinois in 1955. Since then, the military has been making extensive use of this tremendously versatile antenna concept. Until recently, few in the amateur fraternity have known about the log periodic principle.

Through the use of computer-aided design, I have developed three such antennas for use in the amateur bands. The dimensions for the three are given in Table I. All three antennas exhibit a forward gain of 13.5 dB with a front-to-back ratio of better than 15 dB over the specified frequency range. The swr is better than 1.8:1 over the specified frequencies.

The first antenna will cover the range of 21 to 55 MHz; the second antenna will cover 50 to 150 MHz; and the third covers 140 to 450 MHz. These antennas are designed with a 5% frequency overshoot at the low end and a 45% overshoot at the high-frequency end to maintain logarithmic response over the complete frequency range specified. In log periodic antenna operation, approximately four elements are active at any one specific frequency, thus the necessity for the low and high frequency extensions. All three antennas are

Table I. Spacing and Dimensions for Log Periodic VHF Antennas.

	21–55 MHz Array			50–150 MHz Array			140–450 MHz Array		
Element	Length, ft	Dia, in.	Spacing, ft	Length, ft	Dia, in.	Spacing, ft	Length, ft	Dia, in.	Spacing, ft
1	12.240	1.50	3.444	5.256	1.00	2.066	1.755	0.25	0.738
2	11.190	1.25	3.099	4.739	1.00	1.860	1.570	0.25	0.664
3	10.083	1.25	2.789	4.274	1.00	1.674	1.304	0.25	0.598
4	9.087	1.25	2.510	3.856	0.75	1.506	1.255	0.25	0.538
5	8.190	1.25	2.259	3.479	0.75	1.356	1.120	0.25	0.484
6	7.383	1.00	2.033	3.140	0.75	1.220	.999	0.25	0.436
7	6.657	1.00	1.830	2.835	0.75	1.098	.890	0.25	0.392
8	6.003	0.75	1.647	2.561	0.50	0.988	.792	0.25	0.353
9	5.414	0.75	1.482	2.313	0.50	0.889	.704	0.25	0.318
10	4.885	0.75	1.334	2.091	0.50	0.800	.624	0.25	0.286
11	4.409	0.75	1.200	1.891	0.50	0.720	.553	0.25	0.257
12	3.980	0.50	1.080	1.711	0.375	0.648	.489	0.25	0.231
13	3.593	0.50	0.000	1.549	0.375	0.584	.431	0.25	0.208
14				1.403	0.375	0.525	.378	0.25	0.187
15				1.272	0.375	0.000	.332	0.25	0.169
16							.290	0.25	0.000
Boom	25.0	2.0	0.5	16.17	1.5	0.5	5.98	1.5	0.5

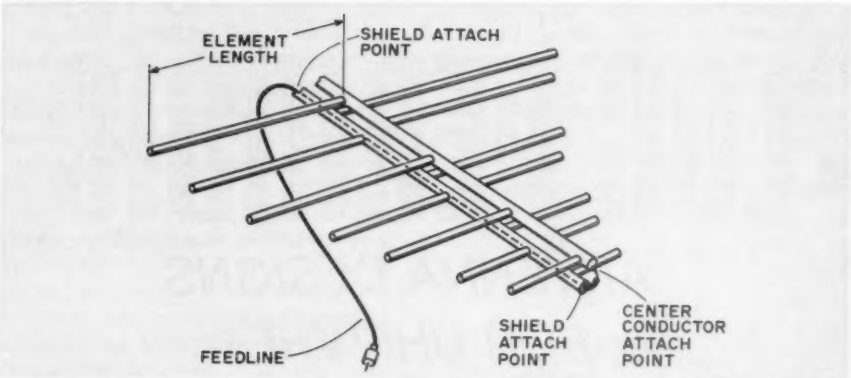

Fig. 1. Typical log periodic antenna. Note that the bottom is fed from the coax shield while the top boom is fed from the center conductor.

designed for a feedline impedance of 50Ω for use with coax such as RG-8/U. All of the antennas are design-rated for 1 kW, 100% modulated. The alpha, or logarithmic element taper is 28 degrees for all three antennas.

Construction

Construction is straightforward, and you can use your own ingenuity as far as fastening the elements to the boom, and also the dielectric spacer configurations. I used heliarc welding for securing the elements, and fiber glass for the dielectric.

Element lengths for the highest frequency antenna were calculated for the elements to be inserted completely through the boom, flush with the far wall. The two lower frequency antennas have element lengths calculated to butt flush against the element side of the boom. If the elements are to be inserted through the boom on these other two (21–55, 50–150 MHz), add the boom diameter to each element

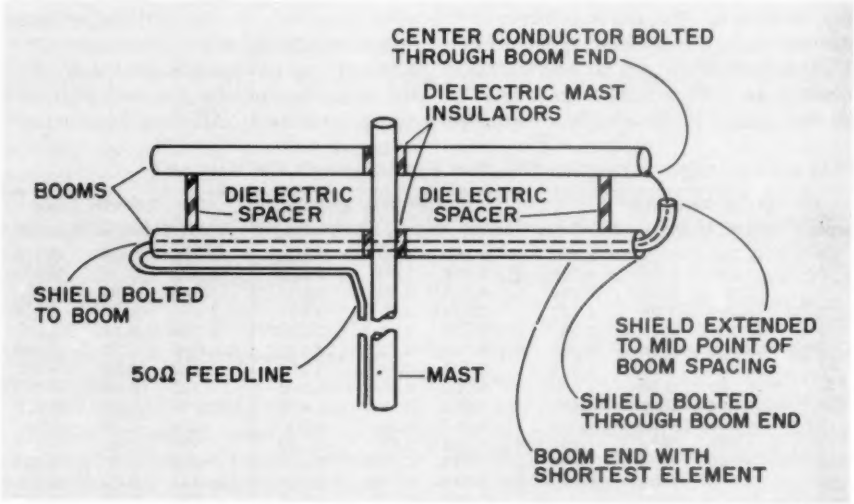

Fig. 2. Feeding the log periodic is relatively simple. Just remove the outer plastic jacket from feedline for the entire length of the boom, so that the coax shield is permitted to short itself inside the boom as well as the solid electrical connections at each end of the boom.

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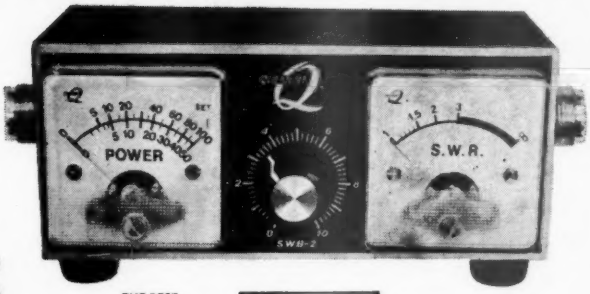

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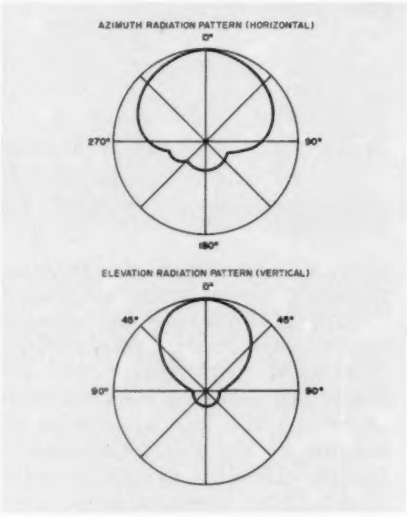


Fig. 3. Typical log periodic antenna patterns.

length shown before cutting the elements.

Two booms must be constructed for each antenna as shown in the isometric view of Fig. 1. Also remember, in supporting a log periodic antenna from a metal mast, the two booms must have a dielectric spacing from the mast of at least twice the boom-to-boom spacing; otherwise you will introduce discontinuities into the feed system.

Feedline insertion and connection are shown in Fig. 1.

Notes

Any change in the listed boom diameters will necessitate a change in the boom-to-boom spacing in order to maintain the feed impedance at 50Ω.

The location of the support mast is not critical; ideally, it should be at the array's center of gravity.

The antennas may be oriented either horizontally or vertically, depending on the type of polarization desired. The horizontal beamwidth of a typical log periodic antenna is approximately 60 degrees, while the vertical beamwidth is on the order of 100 degrees. These are the −3 dB points shown in Fig. 3.

. . . W3DUQ ■

HAM RADIO CHESS

Part I:

One of the enchantments of radio is its flexibility of application. Radio usage need not be restricted to traffic handling, ragchewing, and DX-chasing. An increasing number of amateurs are discovering the potential of amateur radio for the play of various strategic games, such as chess, checkers, and – with some adaptation – even Scrabble.

Chess is perhaps the most popular entry in the radio games category because chess by radio involves no modification to the basic rules of play and there is practically no possibility for cheating.

Radio chess is played almost exactly the same as the game in which both participants sit opposite each other at a board. The only difference is that each player has a board, and each moves his opponent's piece as directed by the opponent himself.

If you're a chessplayer, you know already that each chess piece has its own identifying name, and no other piece on that "team" bears the same nomenclature. Likewise, each square of a chessboard bears a name. Thus, a player can move his piece to the square of his choice, and then announce the move on the radio to his opponent. The opponent, in turn, makes the move as directed on his own board, then responds by making his own move and announcing it.

Part I: HAM RADIO CHESS USING ALGEBRAIC NOTATION

by Kayla Bloom W1EMV

Part II: HAM RADIO CHESS USING THE DESCRIPTIVE NOTATION

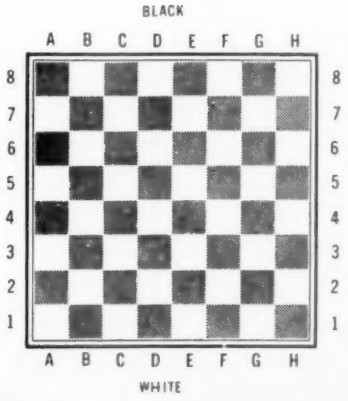
Denys G. Fredrickson WØBMW
3923 East Funston
Wichita KA 67218

Chess by radio is an ideal pastime. It doesn't tie up spectrum or airtime because the only time necessary per transmission is the time it takes to call out a specific move and get a verification from the opponent. While an amateur radio chess game may go on for several hours, there may be less than 10 minutes of accumulated transmitting time.

Most serious chessplayers are already familiar with "descriptive notation," the means by which chess moves in tournament play are recorded for later analysis and replay. Descriptive notation is the system by which each square of the board is identified according to the original piece commanding that square. While this system is easily adaptable to radio play, it is often confusing to those who are unfamiliar with chess terminology.

It also suffers the disadvantage that the squares are numbered differently for White than they are for Black; thus, when Black announces his move, White must remember not to put Black's man on his own square of the same name.

For these reasons, the matrix system (algebraic notation) is in more common general use by amateurs. With algebraic notation, the board is identified by ranks (horizontal rows) and files (vertical rows). The ranks are numbered 1 to 8 from bottom to top (from White's side); the files are identified by the letters A through H from left to right (White's side). This



arrangement yields a matrix that pinpoints each square with a letter/number sequence.

Here's how the moves would sound in a typical opening of an amateur radio game:

1. White: "Pawn to E4."
   Black: "Pawn to E4, Roger; and Pawn to E5."
2. White: "Pawn to E5, Roger; and Knight to F3."
   Black: "Knight to F3, Roger; and Knight to C6."
3. White: "Knight to C6, Roger; and Bishop to C4."
   Black: "Bishop to C4, Roger; and Knight to F6."
4. White: "Knight to F6, Roger; and. . ."

The diagram below shows the positions of the pieces after these three initial moves. (The opening, incidentally, is called "Two Knight's Defense.")

. . . W1EMV ■

Part II:

Are you slightly bored with the general QSO? Is it so dry your lips crack and your ears become dusty? . . ."You're coming in here Q-5 by 9 plus, armchair copy. I'm running a Queenie 5, a swing-a-ling multi-element swizzle stick and the modulator gets excited by the exciter when the oscillator is in oscillation. You have a bodacious signal in here. Before I run, what's my report and your handle again? I couldn't copy." . . .A couple of these and you throw the switch.

If you would like to spend one of the most enjoyable and relaxing 45 minutes you have ever spent, then pull up a chessboard and I'll introduce you to the rapidly growing game of "chess by amateur radio." Worldwide chess at your grubby little fingertips. If you know how the chessmen move, you're qualified and eligible to play chess by amateur radio.

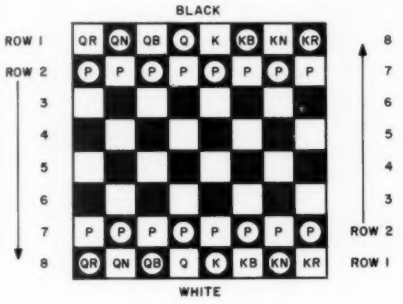
By referring to Fig. 1, you can see that the King row is number one, pawn row is number two, the next row is number three and so on across the board to eight.

Going from right to left each file is designated as follows: King-Rook file, King-Knight file, King-Bishop file, King file, Queen file, Queen-Bishop file, Queen-Knight file and Queen-Rook file. This is all that's required to properly position a piece anywhere on the board.

The important thing to remember is to accurately call out the piece being moved and to where it is positioned. If the piece to be moved is on the King side always preface the piece by saying "King" first. As an example: If the King-Knight were to be moved, one would say: "King-Knight to King-Bishop three" or King-Pawn to King four," or: "Queen-Bishop to King-Knight five."

If you don't know what Knight it is (or day), you will have to set up another

schedule... I mean if you are confused about what knight you are talking about, then state that you are moving it from a particular position to another. Such as: "Knight at Queen-Bishop four to King five."



When there is only one pawn that can capture another piece, you can shorten it by simply saying "pawn takes pawn" or whatever. As you get into the game, numerous shortcuts will be evident. It is also advisable to make a note of each move so if an error should develop you will know how to back up or correct it. The note is a simple "KN-KB3" which reads King-Knight to King-Bishop three. Keep your moves and your opponent's moves listed opposite each other and numbered for easy reference.

I had an amateur television station in operation for the sole purpose of playing chess by TV, but have so far been unable to get anyone else interested in ham TV. I will build another TV station if someone else is interested.

Most of the chess players have been getting together above 14.3 MHz and on 7.250 MHz in the evenings and on Saturday and Sunday afternoons.

If you don't enjoy the time spent playing a game of chess, I will head for the castle on my knight and become a pawn in the court of the King and Queen with the blessing of the Bishop and that's what you call a stalemate. "Try it for kicks"... it's better than "dope." Or maybe it should read: "Dopes should try it for kicks."

... WØBMW ■

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Knight Kit KG-696 RF Generator Kit Review

Elliott Kanter W9KXJ
3242 W Hollywood Ave
Chicago IL 60645

We hams pride ourselves in being equipped for just about any emergency that comes up; but for those times while mountain-topping or operating mobile, when we need a source of rf, we are prone to make do with something less than optimum. I know that I had always wanted a good rf signal generator, but I didn't want to be tied to ac power lines. I did something about my wish and latched on to Allied's KG-696 battery-operated rf generator covering from 400 kHz through 30 MHz.

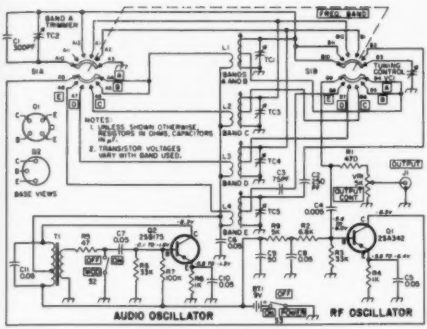
The Knight-Kit KG-696 rf generator showing molded cable assembly.

For those of you who follow changes, the Knight-Kit line has been shifted to Japan and the oriental influence is evident in this little gem. The generator consists of two transistors, a PC board, and a handful of quality components which together make up an interesting package in the less-than-$20 range. The generator contains two separate circuits: an rf oscillator and an audio oscillator.

The frequency selector switch selects one of four rf coils to provide signal output on five bands. The lowest frequency range (400–550 kHz) utilizes the rf coil for the 550–160 kHz band with the addition of some capacitance across the coil to permit tuning 400–550 kHz. Each of the four rf coils features adjustable cores and trimmer capacitors for precise alignment.

The base of the rf oscillator transistor is connected through a capacitor and the band selector switch to a tap on the selected rf coil. This is done to hold transistor loading to a minimum across the coil and provide a high-Q tuned circuit. Feedback necessary for oscillation is provided by a switched secondary winding on each rf coil.

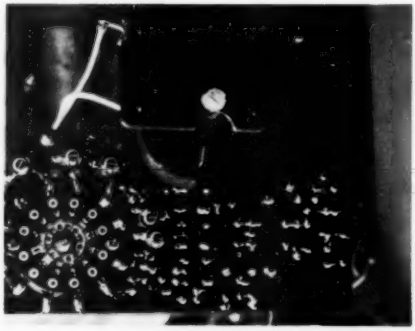
The audio transistor functions as an oscillator generating a 1 kHz signal. A switch allows selection of pure rf or rf modulated by the 1 kHz note. Construction assembly requires approximately four hours with about one additional hour for alignment. A well written and illustrated text aids the new kit builder and proves a valuable aid to the more expert construc-



Physical Size:	5 7/8 x 5 7/8 x 3 5/8 in.
Weight:	2 lb
Freq. Coverage:	Band A- 400-550 kHz
	Band B- 550-1600 Khz
	Band C- 1.6-4.5 MHz
	Band D- 4.5-13 MHz
	Band E- 12-30 MHz
RF Output::	Over 100,000 μV
Modulation:	1000 Hz
Audio:	1 kHz, adjust. intensity
Battery:	9V Eveready 216
Price:	$19.95

Schematic diagram of Knight-Kit KG-696 rf generator and specifications.

tor. The majority of the circuitry is wired to a PC board of first-rate quality, featuring a unique application for converting a conventional wafer-type rotary switch to a PC-type component.



Interior view of PC board highlighting converted switch mounted to PC board.

As the photograph illustrates, the last deck of the switch is soldered directly to the PC board. This is accomplished by first disassembling the switch and reassembling it with the bottom wafer flush against the PC board. This simple operation is secured with somewhat oversized hardware and provides a convenient method of achieving the versatility of a PC-type switch with the economy of conventional components. This technique can and probably will be adapted for use in many amateur homebrew projects. Conventional wiring techniques are used for the other connections to the switch.

At times construction became a bit "hairy," as space was at a premium, but the entire generator rapidly took on the appearance of a mechanically and electronically stable piece of ham gear with no major problems.

Battery replacement, frequently a problem with solid-state gear, is simple. The battery (9V transistor type) is held in a clip with conventional snap-on terminals. This clip is part of a bracket secured to the bottom of the case with the battery inside.

Alignment

The entire alignment procedure is based on the use of standard broadcast station frequency reference points for the range from 600 to 1600 kHz, and a ham receiver for checkpoints on the higher bands. Shunt capacitors are included in the event the core adjustment and trimmer adjustments fail to bring the unit to satisfactory alignment. A small quantity of wax is included to be melted and deposited in the cores and on trimmer screws to prevent movement once alignment is complete.

Comments

The KG-696 represents an inexpensive means of achieving a reliable source of rf and is portable and nondependent on ac power lines. It is useful for on-site adjustments as well as a reliable fixed-station performer. Its price – less than $20 – puts it in the buying range of many of our newer hams who, though never short on ideas, are often short on capital.

. . . W9KXJ ■

Dick Brubaker
Applications Engineering
Motorola Semiconductor Products, Inc.
Phoenix, Arizona 85036

A VHF AM USING LOW-COST TRANSISTORS

TRANSMITTER

This report describes a broadband VHF AM transmitter that has an output power of 4W over a range of 118–136 MHz with an rf input of 5 mW. It requires no tuning in changing frequency.

Though the transmitter is not designed for amateur use, it illustrates many principles of interest to hams, and it could probably be retuned for the 2 meter band.

The transmitter operates from a 25V dc supply; the rf circuitry is designed for operation from a 12.5V supply with collector modulation and the 25V dc requirement is due to the series modulation employed. The modulator described in this report does not require a modulation transformer, yet provides upward modulation of over 90%. In cases where it is necessary to operate the entire transmitter from a 12.5V dc source, a conventional modulator utilizing a transformer could be employed.

Fig 1. Block diagram of 4W VHF AM transmitter.

This note includes sections discussing the transmitter circuit and performance, design considerations, circuit layout, and testing. An additional section is included describing the modulation system used.

Circuit Description

The transmitter consists of four common-emitter amplifier stages. The block diagram is shown in Fig. 1.

The output stage (Q4) uses a Motorola 2N5642 balanced-emitter transistor (BET). These transistors were developed by Motorola to eliminate failures common in earlier rf power transistors; BETs are highly resistant to secondary breakdown due to mismatching and detuning. The 2N5642 is mounted in the stripline opposed-emitter package, which provides low-impedance strip connections and excellent isolation between the base and collector. The package is shown at the left. All terminals are electrically isolated from the stud for ease of mounting. The 2N5642 is capable of 20W output in CW or FM service, but must be downrated for AM use.

The input amplifier (Q1) is a plastic-encapsulated MPS918 transistor in the TO-92 Unibloc package. Detailed specifications on these transistors are available in the Motorola Semiconductor Data Book, or from individual data sheets.

The driver stage (Q3) uses a 2N3553 and the predriver (Q2) uses a 2N3866. These are small rf power transistors in the TO-39 package.

Amplitude modulation is applied to stages Q2, Q3, and Q4 with the supply voltage to Q3 reduced slightly with a small series resistor. A separate unmodulated dc voltage (12.5V) is applied to Q1. Two

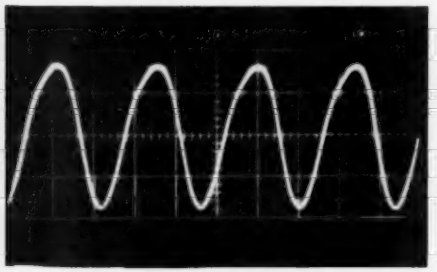


Fig. 2. Output carrier at 136 MHz (V_{CC} = 12.5V).

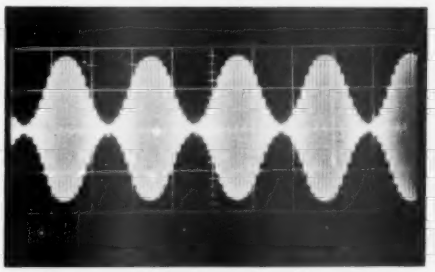


Fig. 3. Composite modulated output signal at 136 MHz (V_{CC} = 12.5V). Modulating frequency: 1 kHz.

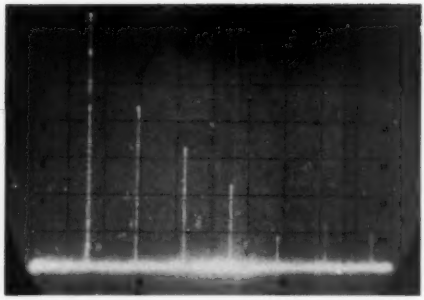


Fig. 4. Output spectrum with 136 MHz carrier (VCC = 12.5V).

diodes are used to limit the downward modulation to Q2.

Circuit Performance

Typical performance data for the transmitter is given in Table I. The driving source is a standard signal generator with a 50Ω output impedance.

The actual output waveshape at 136 MHz monitored by a sampling oscilloscope is shown without modulation in Fig. 2 and with modulation in Fig. 3.

Figure 4 shows the frequency response of the 136 MHz carrier on a spectrum analyzer. The spurious response data and output power shown were measured without an output filter.

Design Considerations

As previously discussed, the overall objective of this transmitter is a broadband modulated output. That is, the transmitter must be capable of being modulated in excess of 85% from 118 MHz to 136 MHz

	136 MHz
Power output, unmodulated (rms)	4W
Power output, modulated (rms)	5.9W
Power supply voltage (at collector of Q4)	12.5V
Power supply current (total)	530 mA
Collector current, Q4	400 mA
Power input, unmodulated (rms)	5 mW
Typical upward modulation	97%
Envelope distortion	7.9%
Harmonic Output:	
Second harmonic frequency	-24 dB
Third harmonic frequency	-35 dB
Other frequencies	-40 dB
Spurious sideband output for f_m = 1 kHz:	
Sideband amplitude at second harmonic of modulating frequency	-23 dB
Sideband amplitude at third harmonic of modulating frequency	-32 dB
Sideband amplitude at fourth harmonic of modulating frequency	-44 dB

Table I. Performance of Broadband Transmitter.

with a minimum power output of 4W; consequently, any circuitry or device used must be considered from the viewpoint of broadband modulated output rather than narrowband unmodulated output. Considering first the devices, a primary requirement here is overdrive. That is, each stage must be slightly overdriven to achieve the desired bandwidth. Since each stage is overdriven, the overall stage gain is less than that potentially possible in a normal narrowband test circuit.

Another important consideration involves the interstage networks used to transform the input admittance of one device to the required collector loading of a lower level device. Although circuit Q is important, stability and upward modula-

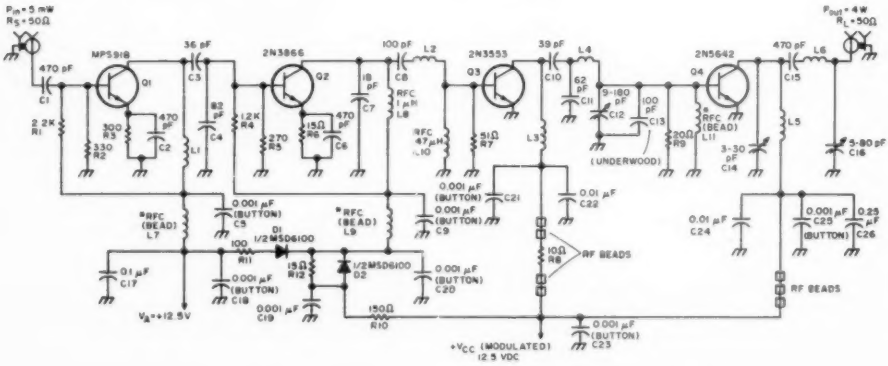


Fig. 5. Schematic diagram of broadband AM transmitter.

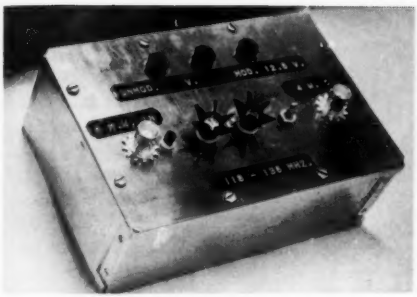


Fig. 6. Top view of transmitter.

Fig. 7. Bottom view.

tion capability are equally important. One approach that can be used is to design a tentative network at mid-band (127 MHz) for a Q of 1. Incidentally, it should be pointed out that the large-signal admittance data shown on most rf power transistor data sheets is for narrowband design only. Any design involving an overdriven stage is an approximation. The circuit values can then be optimized in each network by driving the transmitter with a modulated power sweep generator.

A brief description of each stage is as follows. First, the 50Ω load is transformed to the collector of Q4 with a *pi* network. The required drive power to Q4 is approximately 630 mW for an output power level of 4.7W. The input to Q4 uses a large capacitor from the base of Q4 to ground to tune out the base lead inductance. A low-inductance capacitor is highly recommended.

The driver stage (Q3) is also collector-modulated with full upward and downward modulation. The drive level to Q3 is approximately 200 mW.

The predriver stage (Q2) is also collector modulated; however, it is primarily modulated upward. The downward modulation is limited by diodes D1 and D2. Diode D2 does not conduct during the downward modulation cycle, so Q2 is only upward modulated. When D2 is not conducting, D1 conducts and provides Q2 with a constant 12.5V supply. Both diodes are contained in one plastic-encapsulated package (MSD6100).

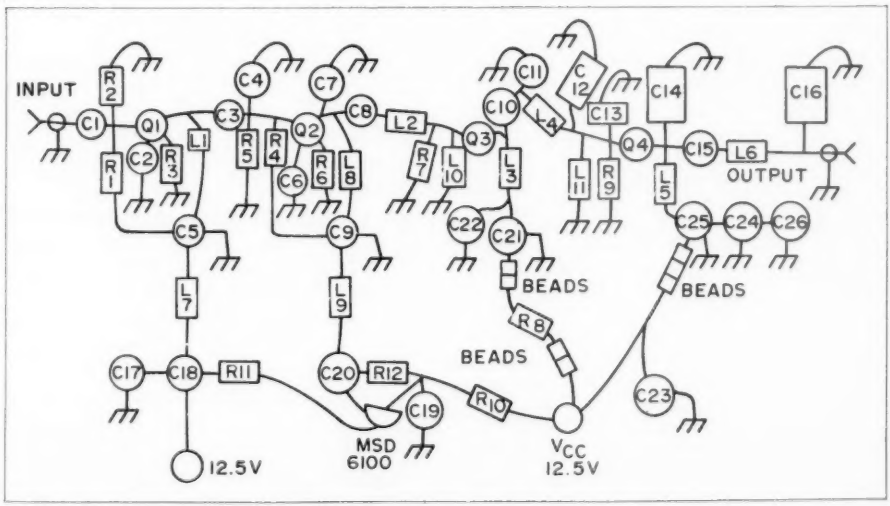


Fig. 8. Suggested component layout.

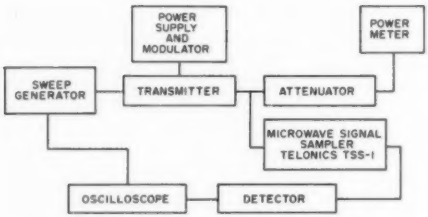


Fig. 9. Block diagram showing power sweep test.

The required input power to Q2 is 32 mW.

The input stage (Q1) is operated class A with no modulation. To insure that no instability occurs, this stage should be driven from a 50Ω source.

Circuit Layout

Careful attention must be paid to circuit layout. Figures 6 and 7 are top and bottom views of the transmitter, and Fig. 8 provides a layout of the components used in the transmitter.

The circuit is constructed on a 6 x 3¾ in. phosphorus–bronze metal plate 1/32 in. thick. The first three stages (Q1, Q2, and Q3) use sockets. The output stage (Q4) is stud-mounted directly to the chassis.

Test Setup

An important consideration in testing as well as the component optimizing of the transmitter is the test setup. The block diagram shown in Fig. 9 shows a power sweep technique. The primary advantage of this approach is that the results of individual component changes can be observed over a wide frequency range rather than simply at an individual frequency. Consequently, two important factors important in wideband transmitters, bandwidth and instability, can be observed across the band.

A sweep generator drives the transmitter. If drive power in excess of that

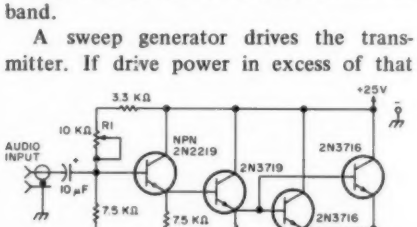
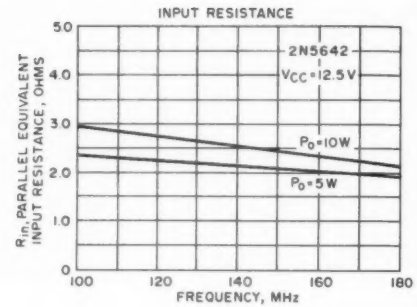
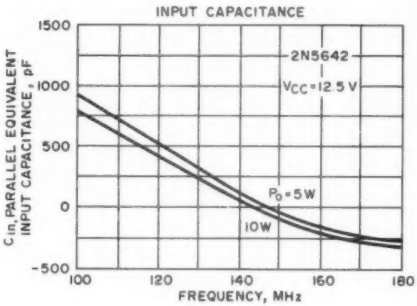


Fig. 10. Series modulator for 4W transmitter.





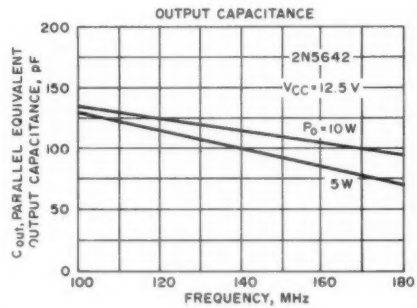
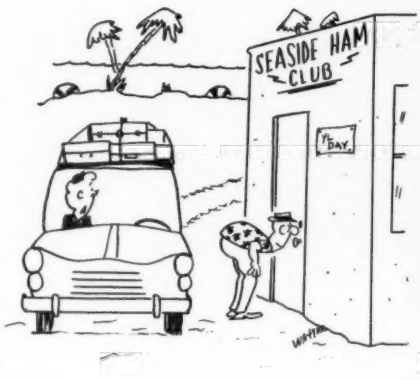


Fig. 11. Impedances of 2N5642 with 12.5V collector supply.

obtainable from the sweep generator is required, another transmitter can be used; that is, the sweep generator can be used to drive a transmitter, which in turn can be used to drive the circuit under test. This approach can provide high-level modulation; the transmitter supplying the drive power can also be modulated upward.

Modulation

Collector modulation usually requires a significant amount of audio power in conjunction with a large collector current. Consequently, if a transformer is used, it



"Can't you forget for two weeks out of the year that you're a ham!"

Buy 73 binders and win the love of a beautiful girl. Now only $4.00!

must be capable of operating with a large collector current circulating through its secondary winding, as well as supplying the required audio power. In addition, the transformer should furnish the required impedance-matching low distortion and low dc resistance in the secondary, since a significant dc voltage drop across the secondary winding will reduce the effective dc voltage applied to Q4.

An alternative approach is shown in Fig. 10. This method utilizes an audio power transistor instead of the transformer secondary. The collector supply to the modulator is 26V. The dc voltage to the transmitter is adjusted with R1. Although this modulator has several disadvantages such as thermal drift and distortion, it nevertheless provides a convenient method of modulating a transmitter. A more practical series modulator could include external feedback to reduce envelope distortion. The modulator shown in Fig. 10 has a harmonic distortion less than 1%. The modulator shown has been used to modulate transmitters with unmodulated carrier powers up to 35W.

Figure 11 includes three characteristic charts for the 2N5645 with 12V collector potential.

Acknowledgment

The author wishes to thank Ed Loupe for his many useful suggestions and comprehensive laboratory data generated in conjunction with the design of this transmitter.

Brubaker ■

References

1. "Matching Network Designs with Computer Solutions," Motorola Application Note AN-267.
2. "Systemizing RF Power Amplifier Design," Motorola Application Note AN-282.

YOUR CALL

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Joseph M. Plesich WB8YIF
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RAISING a RHOMBIC

Me! Put up a rhombic?"

"Why not?" said Vince, "After all, you already have the toughest part of the job done."

"I do?"

"Sure. You've got three acres on top of a hill."

And this is how my rhombic began. Vince, K8LQM, our club treasurer, who is affectionately kidded about being K8L*QRM*, kept reminding me about what a shame it was for a ham to have all that land, and yet not have it covered with antennas.

I had to admit it. Ol' Vince had me thinking. I even started to have visions of DX calling me instead of vice versa. Anyway, after more encouragement from Vince, I decided I'd give it a try.

A-Frame Construction

Vince and I decided to make my rhombic 137 feet on a leg. Why this size? Simple. It would fit nicely within the property boundaries of my back yard.

Since I did not have any strategically located utility poles, trees or towers, and did not wish to spend much money to purchase any, my next question was "How do we support all that wire?"

"Easy." he replied in a tone that was just a little too nonchalant for me. Vince took pencil and paper in hand and sketched the 40 ft A-frame mast shown in Fig. 1 and the photographs. Although many articles say that the top section of the A-frame can be made of 2-by-3s, we used only 20 ft 2-by-4s. It may not have been necessary, but they were available, and we liked the added strength and rigidity it gave to the completed mast. Also, don't forget to run bolts through the bottom of each leg of the A-frames as shown in the illustration. This will keep the legs from splitting.

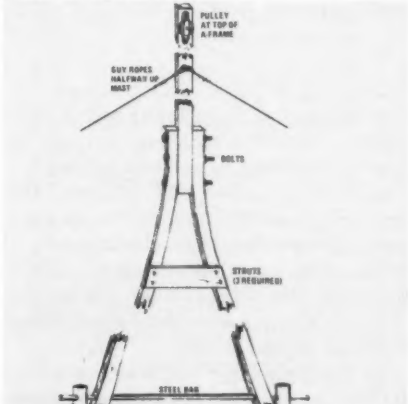


Fig. 1. A-frame construction details.

Next, I felt I'd like to be able to get these A-frames up in the air with a minimum of fuss and manpower. Again, Vince had the answer. Pivot them. This we did, as shown in the illustrations and photos. This system enables two men to "walk up" without much trouble at all. In fact I – weak ol ' pencil pusher that I am – was able to steady it all by myself while Vince tied down the guys. Even if you are not going to put up a rhombic, the A-frame

Vince (K8LQM) gets the soft job of putting the A-frames together while the author sweats over the picture-taking chores.

makes a dandy, inexpensive support for an inverted vee, VHF beam, or both.

Once the first A-frame was built, it certainly wasn't any problem to make three more of them. In fact, Vince and I were able to drill the holes and bolt them together in about 20 minutes.

When the A-frames are completed, put a couple of coats of paint on them. You can raise them up off the ground and lay them across two or three sawhorses and make the painting job a lot easier.

Vince thought it would be a good idea to paint each A-frame with a different color in a barberpole design. I painted them white. After all, they can be seen for two miles as it is, and how would it look if a high-school guidance counselor were hauled off to the happy farm for having psychedelic poles in his back yard.

To the top of each A-frame we attached pulleys, and passed ropes through them. Finally, we attached the guy ropes. Then, when we swung them up into the air, all we had to do was fasten the guy ropes to stakes in the ground. After all the A-frames were standing, we attached an insulator and antenna wire to the pulley ropes and pulled the antenna into the air. (With this rope-and-pulley system, minor tension adjustments are very simple to make.)

Feedline Construction

If you are still with me, you are probably asking yourself, "Now that that nut has that monstrosity up, how does he feed it?" Well, I should feed it skeptical, unadventurous hams, 6 meter beams, and XYLs, but I don't. I feed it with open-wire line as shown in the illustrations. How long is it? It's just long enough to reach the transmitter – which, in my case, is about 130 ft.

I made the feedline out of 14 AWG wire and 3/8 in. dowels. Since I had plenty of it available, I used 18-gage copper-clad steel wire to attach the feedline to the spreaders as shown in the illustration. This made my ladder line so strong I could almost climb it.

Perhaps you are wondering why we made the feedline 9 inc wide. Well, the dowels came in 3 ft lengths. Not wanting to waste anything, we just cut them into 4 equal 9 in. lengths. It works fine!

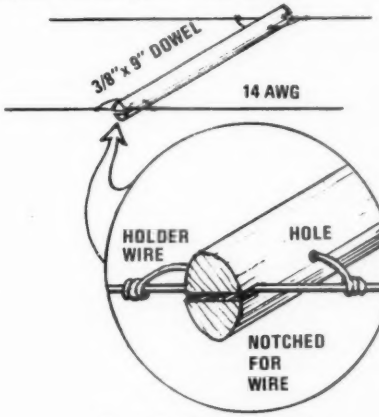
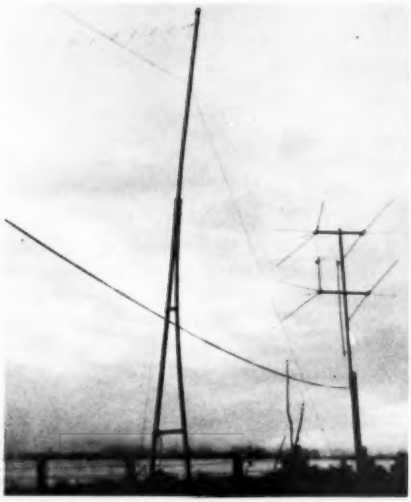


Fig. 2. Feedline construction.

This is the author's method for bringing the ladder line into the shack.



A "ladder line" open-wire feeder carries the signal from the house to the feed point on the nearest A-frame.

Especially if you have never used open wire before, you will have to figure out a method for bringing this type of feedline into the shack. I live in a frame house with the shack located in the basement. My method is the one shown in the illustrations and photos. Purists might disagree with it, but, again, it works for me.

Operation

The biggest test of all, of course, is its performance. First, though, let me give you the equipment lineup. The rigs in use at W8DYF are Hallicrafters SR-42, Heath HW-16, Drake TR-3, Johnson Matchbox, and a Knight bridge.

Using one configuration or another on the Matchbox I have been able to load the antenna on phone and CW on every band. I can't give you any gain figures, but a couple of VKs and ALs have told me I have a very good signal for 300W PEP barefoot. A WØ in Denver told me I had the needle on his S-meter shoved up as far as anyone has ever put it. Frequently, when ragchewing, fellows will break in just to tell me what a good signal I have.

Fig. 3. Feed point details.

Every Sunday at noon I work W8ZRI/4 in North Carolina. He usually gives me a report of 55 to 60 over. Even field day did not interrupt our schedule. We just talked right through that mountain of QRM!

One thing I am going to try is putting a terminating resistor at the far end of the antenna so that the pattern will be broader, for I do find it to be pretty sharp. For example, one night after the skip had gone out on 10 meters, I called W8DRW, a good friend of mine who lives about 18 miles south of me. He could barely hear me. However, when I tied the feeders together and fed it with the Matchbox as a random length of wire, he was comfortable copy.

I've also been using the antenna with my SR-42 and a homebrew antenna coupler on 2 meters. It seems to work fine, but seems to be pretty directional.

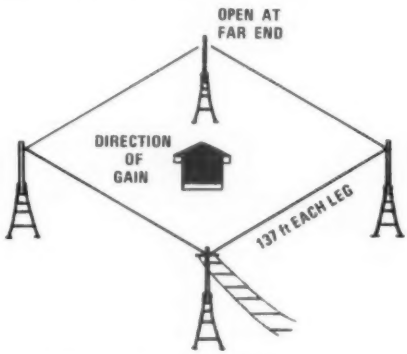


Fig. 4. Layout of raised rhombic.

All in all, I'm very pleased with the antenna. It is rather inexpensive and it permits me to operate over a wide variety of frequencies with only one antenna. Also, it's quite a conversation piece on the air. So even if you can't raise your own rhombic, I hope I've given you some ideas for a QRM killer of your own.

. . . W8DYF ■

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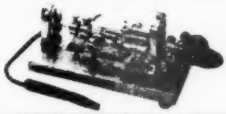

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LEAKY LINES *(cont. from page 12)*

Why, then, are devices like can openers and electric blankets not equipped with condensers at the time of manufacture? Again, it's dat ol' debbil, money!

Despite my seeming tongue-in-cheek jocularity in this piece's opening gambit, there's a kernel of serious purposefulness in my statements. I really cannot for the life of me understand why the FCC, which has tremendous influence in all phases of the electrical and electronic manufacturing field, does not put some real teeth into some specification requirements. If any electrical device fails to meet acceptable standards with respect to interfering radiations, a temporary injunction could easily be invoked, enjoining further production until the problem is overcome. This is no more radical than the control of production in the food and drug categories, when health is imperiled as a result of substandard operations. After all, a few cents' worth of components would not impoverish these companies, or cut seriously into their profits, notwithstanding the copious crocodile tears and their howls of anguish whenever they speak of production costs. A cursory glance at the figures on corporate earnings will disclose that these industrial firms, in the main, enjoy lucrative returns on their investments. Chiseling on the price of equipment, for that is what this amounts to, is simply not justifiable on the grounds of economy. Such economy, if it is not passed on to the consumer in the form of lower costs, is really nothing, more or less, than a way to increase profits.

Why not an approval stamp, issued by FCC, attesting that the appliance is free of interfering radiations, and meets proper standards? Why not an industrial-wide code establishing such standards? We have grown used to the endorsement of the Underwriter's Lab, which reassures us as to safety from shock and fire hazard. What is so terrible about a device having to meet additional standards with respect to interference?

Remember, all it takes is an aroused and organized group. We can make our ideas heard and heeded, if only we channel our energies together. Let's make sure that not another amateur receiver is plagued unnecessarily by extraneous noise, ever again. So, man the barricades! Storm the bastile! Oust the scoundrels!

Then the only thing we will have to worry about are plain, oldfashioned 40–over–9 unmodulated carriers jerks hollering "Hello, test. Hello, hello, test!" and pests who swish their vfo's back and forth over the whole band, while the transmitters are on lock key. That's all we'll have to bother us.

Some fun, eh, kid?

. . .K2AGZ ■

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TVI from an Antenna Rotator

After several years of patient labor under tribander overload, my faithful AR-22 threw in the towel by breaking its bearings.

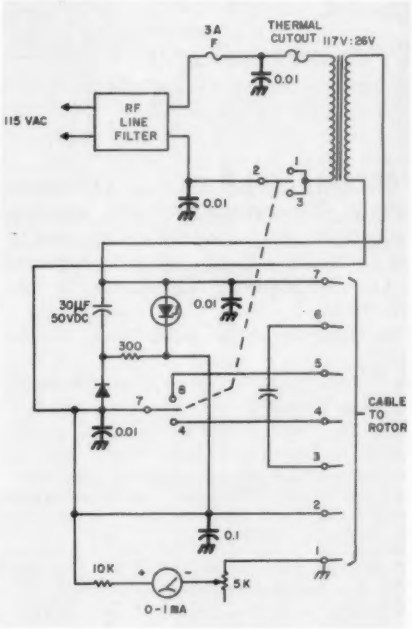
Since the need for upgrading was obvious, I purchased and installed a TR-44 rotator; and once more all was well in the beam spinning department.

However, during the course of a routine TVI check, a crosshatch which had not been there before, appeared on channel 6 at all power levels over 50 watts. Although located in a strong signal area, fringe area reception is simulated by using a filtered TV receiver, with indoor dipole, in the shack right under the beam. Normally, all channels are clean with 500W input on 20m.

Locating the source of TVI would sometimes try the patience of a saint, and this case was one of those times. The clue, which finally led to the detection of the culprit, was a small upscale movement, with keying, in the direction indicating meter on the TR-44 control box. This unit uses two diodes in the meter circuit – one to rectify the meter current, and a zener for meter voltage regulation. The long, multiwire cable from rotor to control box makes an excellent antenna, both to pick up the transmitter rf and to radiate the harmonics caused by diode rectification of this rf.

The rotor cable leads were bypassed to the chassis with five 0.01 μF 1 kW ceramic capacitors, as shown in the schematic. To gild the lily, a CF IF-54 rf line filter was installed in the ac line to the control box.

The meter now remained immovable with keying and the channel 6 crosshatch was gone. In this case, the interference was



Schematic of rotator with added capacitance shown in bold.

light and not of much consequence with a strong TV signal; but in a fringe area, it could have been troublesome in many respects.

Edwin Hill W3URE ■

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Stephan Goldstein
146 Eighth Street
Providence RI 02906

The IC mitter

This transmitter was designed with the QRP fiend in mind. It uses inexpensive ($3.80) RCA type CA3000 integrated circuits. As crystal oscillators they will work to about 10 MHz, and if you're lucky you just might be able to use them at 20 meters. This transmitter will work on 160, 80, 40, and maybe 20. This contraption will put out AM or CW at the flick of a switch.

The schematic should be self-explanatory. If you build on Vector board I would recommend using sockets. As a matter of interest, the 2N3904 is for agc. Capacitor C1 should be chosen for good agc action – try 0.05 or 0.1 μF. Transformer T1 is a swamped 10 to 5 kΩ matching transformer. The values shown for it give a fairly good match. The C2-L1 network should resonate at the crystal frequency. Tap L1 wherever you get the best match. The AM-CW function is switched by a 3-pole double-throw wafer or toggle switch. For AM work, use a 50Ω mike (or something close).

These circuits are by no means completely original. Only partly. They were lifted from RCA publication ICAN5030. Also from File 121. Both are available from RCA for the asking. These papers provide much useful data on the CA3000.

Have fun!

Stephan Goldstein ■

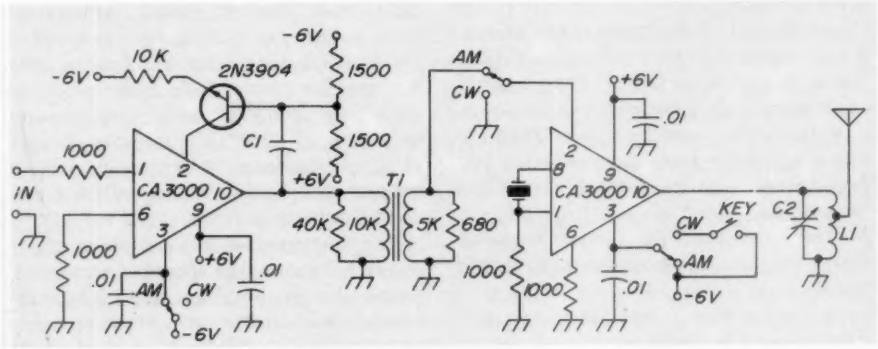

Fig. 1. See text for C1, C2, L1, T1. For CW you can also switch out the transistor if you want. Instead of keying the voltage, you could key the output. If you don't want agc, simply ground pin 2 of the first IC.

STUDY GUIDE GENERAL CLASS LICENSE

PART II
Now you see it, now you don't!

The General Class license examination covers many fine points of radio theory and practice – and many most basic points as well. Since the basics are necessary as a foundation upon which to build the fine points, we began this study course in our previous installment by accounting for voltage, current, resistance, magnetism, and the propagation of electromagnetic energy.

And since our space was, as always, limited, we did not get around to many of the basic points involved in ac circuits. That's our subject this time.

If you missed the previous installment, by all means obtain a copy before going further in this one. The two actually fuse into a single discussion, and we'll be making frequent reference to points covered before.

As always in these license study courses, we're working from the official FCC study list of "typical questions" – but we're not answering the Commission's own questions. Instead, we're expanding their range to cover a broader area, and examining that broad area in as great detail as we find necessary.

This time, the FCC questions we will cover are (numbers from the study list, as usual):

3. Define skin effect. How can this phenomenon be minimized?

33. What are the distinguishing features between series-tuned and parallel-tuned resonant circuits? How is the resonant frequency determined? Define the "Q" of a resonant circuit?

38. What is inductive reactance? Capacitive reactance? How is their value determined? How do like reactances combine in series? In parallel?

In addition, we will be winding up portions of questions 27, 35, and 36, which were begun last time around.

Because we know from our previous study what inductance, capacitance, volts, ohms, and amperes are, as well as series and parallel circuit connections, but have not yet met "reactance" or "resonant frequency," let's begin by asking "HOW DOES AC BEHAVE DIFFERENTLY FROM DC?" This will permit us to explore not only reactance and skin effect, but a more basic concept called impedance. From there, we will try to determine "What is resonance?" This discussion sets the stage for much of the later "practical work" on tuning of both receivers and transmitters. The "Q" factor is closely allied to "resonance," but is enough different that the question "What is Q" deserves its own discussion.

By the time we explore these three general questions, we should have a solid foundation in both ac and dc circuit theory, and be ready to move on to some advanced theory by next time around. Let's get started, then.

How Does AC Behave Differently From DC? We saw last time out that ac must be

measured differently from dc, because of the fact that ac is continually changing not only its intensity but its direction of current flow. We said at that time that voltage, current, and resistance were not so simply related in an ac circuit as they are with dc, as well, but we didn't dig in any deeper.

Let's do so now. Last time, we saw that resistors convert electrical energy to heat energy, that inductors impede changes in the flow of current, and that capacitors contain insulators which interrupt the steady flow of current.

All these effects are perfectly true of steady-state dc. With ac, however, there never exists a "steady state," because both the intensity and the direction of the current are always changing.

In a capacitor, for instance, a steady or dc potential will cause an accumulation of charge across the insulator or dielectric. If the potential is then increased, the charge which already exists will be of the same polarity. Since like poles repel each other, the charge already existing will tend to oppose the increase.

However, because of the "brute force" provided by the increased potential, electrons *will* move within the dielectric to establish a new state of charge and bring the capacitor's charge into balance with the applied voltage. Only after this movement has occurred will the full applied voltage exist across the insulation. The time involved is exceedingly small, but the net result is that a capacitor delays the voltage until current flow has stabilized.

If we apply ac rather than changing the voltage of applied dc, the same basic rules apply – except now, the current flow never stabilizes. It just keeps on changing, and the voltage never quite catches up to it. The net result is that the voltage cannot reach a peak value while current is flowing, and when current is at a peak of intensity no voltage exists across the capacitor.

In between these times, current will decrease from its peak as voltage increases from zero.

We express this by saying that the voltage "lags" behind the current.

Most usually, a simple statement that the voltage is lagging doesn't describe things accurately enough. We need to know just how far behind the current peak the voltage peak is located.

We could express the time in fractions of a second, but then we would also have to specify the frequency of the ac involved. To avoid this entanglement, we use the ac cycle itself as our time scale. Recall our simplified ac generator of last installment, which generated one full cycle of ac during one revolution of its shaft through 360 degrees of arc. We use this fact, and say that a full cycle of any ac sine wave occupies 360 degrees of a phase; that's our way of measuring time in ac circuits.

Since a full cycle is 360 degrees, let's arbitrarily set our zero-degree point on the instant when the current is crossing zero in a positive-going direction. The current's positive peak will then occur 1/4 cycle later, or 90 degrees. The next zero crossing will be another 1/4 cycle later, or at 180 degrees, and the negative peak will be still another 1/4 cycle after that, or at 270 degrees. At 360 degrees, we will complete the cycle and be back at the "zero" point of the next cycle.

To apply this to the voltage lag in a capacitor, let's see what happens to the voltage at these same four points in the current waveform.

When the current is at zero degrees, with the waveform crossing zero and going positive, the voltage is at its negative peak. This is the 270-degree point on the previous cycle, or 90 degrees behind the current.

When the current is at 90 degrees, at its positive peak, the voltage is just crossing zero going positive. This is the zero-degree mark of the current cycle, the same intensity which the current had 90 degrees earlier. Voltage is still 90 degrees behind current.

And, in fact, all the way through the cycle, the voltage is always 90 degrees behind the current – if a perfect capacitor is used, with no resistances anywhere in the circuit. This, of course, cannot be achieved in practice, but we can come astonishingly close.

Note that there's a very major difference here from what happened in the dc-circuit. With dc, the capacitor blocked all current flow. With ac, current flow continued right on through the capacitor, but the "lock step" relationship between current and voltage (which existed when the ac left its generator) has been disturbed, so that voltage now lags by 90 degrees.

Since we're assuming that there was no resistance anywhere in the circuit, no energy was turned into heat. However, with the current and the voltage waveforms out of step they are no longer capable of producing the same amount of power as they were before meeting the capacitor. The energy has undergone an apparent loss, but actually it's just out of time.

Because this apparent loss is due to a reaction brought about by the capacitor, we call it an effect of "reactance." Because the apparent loss is real enough to affect any circuit connected to it, we measure reactance in ohms just as we do resistance. The major difference between reactance and resistance, at this point of the game, is that resistance loses the energy permanently by turning it into heat, while reactance merely locks it up and makes it unavailable for us to use.

Going back now to the reason why voltage and current get out of step with a capacitor – the fact that the existing charge at any instant opposes any increase in charge – it shouldn't be extremely difficult to see that the more rapid the attempted increase, the more rapidly the change will occur. Similarly, the greater the capacitance involved, the more thinly spread will be the "existing charge" and the less it will be able to oppose the changes.

These two observations lead us to the point that the *greater* the frequency of the ac signal, and the *greater* the capacitance in question, the *smaller* will be the reactance..

Going in the other direction, as the frequency becomes ever lower it gets closer and closer to being dc, and since a capacitor is an open circuit for dc it must be a very high value of reactance for very low frequency ac. There's a formula for calculating reactance in ohms of any capacitor if you know its capacitance and the frequency of the ac signal involved, but we won't go into that just now. First, let's look at another form of reactance.

We have just seen that a capacitor introduces reactance into an ac circuit because its charge opposes any change in voltage across itself. We also know that an inductor opposes any change in current.

Because of this, the reactance of an inductor does not cause the voltage to lag behind the current as does that of a capacitor. Instead, with an inductor, the current lags behind the voltage.

The reasons are exactly parallel, however, to those which apply in the case of the capacitor. When the current flow is zero, there's no opposition (for a brief instant) and voltage intensity is at its peak. When current flow is at a peak, opposition is at a maximum and voltage hits zero. Just as with the capacitor, the inductor's reactance causes voltage peaks to coincide with zero-crossings, and the voltage zero-crossings to coincide with current peaks.

This means, automatically, that a 90-degree phase difference is introduced between the current and voltage waveforms by pure inductive reactance. Since it's the current which is delayed, this time the voltage is 90 degrees ahead of the current rather than 90 degrees behind.
delayed, this time the voltage is 90 degrees ahead of the current rather that 90 degrees behind.

Figure 1 illustrates both of these conditions, as well as the normal nonreactive relationship between voltage and current in a resistive ac circuit.

Current lag instead of voltage lag is not the only difference in a reactance between capacitors and inductors. They behave a bit differently with respect to inductance values and to frequency, also.

The more rapid the attempted change of current in the inductor, the more opposition is developed. Going the other way, the nearer the signal frequency gets to dc, the less effective the inductance is, since inductance has no effect at all on steady-state dc.

This means that while the reactance of a given capacitor decreases as frequency goes

up, the reactance of a given inductor goes up as frequency increases. The higher the frequency, the greater the reactance.

Similarly, the greater the inductance at any one frequency, the more the opposition. Thus the reactance increases as the inductance value climbs, while capacitive reactance decreases as capacitance is increased.

Since capacitive reactance and inductive reactance behave so differently in these three different areas, we must have some way of telling them apart in our equations and theories. The behavior is so different that they almost appear to be opposites. One causes current to lead; the other causes it to lag. One increases with frequency; the other decreases. One decreases as its corresponding unit increases; the other increases right along. This "opposite-ness" of characteristics is used to tell them apart in our symbols. We use the "+" and "-" signs of arithmetic to designate which kind of reactance we mean. If the reactance is capacitive, we tag it as "-"; if it's inductive, we call it "+."

This would indicate, and Fig. 1 would back us up on it, that we could use some of

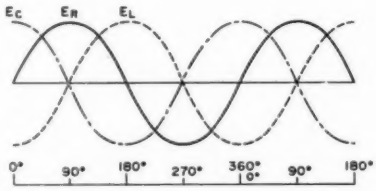

Fig. 1. Effects of capacitance, resistance, and inductance on phase relation between voltage and current are shown here. In all three cases, current phase is same as waveform E_R. Capacitance causes voltage phase to lag 90° behind voltage, which is same as causing voltage to lead current by 90°. Phase scale at bottom refers to phase of current waveform.

one kind of reactance to cancel out some of the other kind. As a matter of fact, we can do just that, and we're going to look at that process in great detail rather shortly. All we'll mention about it here, though, is that this gives us a "key" to "unlock" the power which was locked up in the ac signal by just one kind of reactance.

Now let's turn the tables just a bit, having met both kinds of reactance, and find out how to relate capacitor values in microfarads or inductances in ~~henries~~ to reactances in ohms.

It takes a bit of algebra, but nothing more complicated than Ohm's Law. Figure 2 shows the equations, in two forms. The

$$X_L = 2\pi fL$$

INDUCTIVE REACTANCE
(full formula, ohms, hertz, henries)

$$X_C = \frac{1}{2\pi fC}$$

CAPACITIVE REACTANCE
(full formula, ohms, hertz, farads)

$$X_L = 6.283fL \qquad X_C = \frac{159}{fC}$$

X	in ohms	X	in ohms
f	in megahertz	f	in kilohertz
L	in microhenrys	C	in microfarads

Fig. 2. Reactance equations. Versions at top are full basic formulas, with all quantities in "basic units." Those at bottom are practical versions. See text for details on their use.

first form of each equation is the full basic form, with all units in "standard" values such as hertz (cycles per second), farads, henrys, and ohms. The second form of each is the "practical" one for radio work, with units in more convenient form such as μF, kHz, μH, etc. The answers, however, still come out in ohms.

In case you're wondering how "pi" gets into the act in the first form of each equation, the answer gets a bit sticky. The most completely basic form of each equation is one of Maxwell's equations, which deal with rates of change and so involve concepts met in differential and integral calculus. To get from the "curl" of the electric and magnetic fields down to the "ohms" values which are of practical interest to us, it's necessary to go through

some partial differential equations. These, in turn, don't work with "degrees" or hertz, but instead with "radians," which are a different way of measuring angles that depends upon the ratio between the radius of a circle and the arc cut out of that circle by the angle involved. To convert from "radians per unit of time" into "hertz," we have to convert a measurement based on the circumference of a circle into one based on the number of revolutions. "Pi" is the factor which relates these, and that's why the reactance formulas both include "2 pi" as a factor.

"2 pi" as a factor.

In practice, of course, you don't have to worry about "pi" at all – because the magic figure "159" with the appropriate number of zeros fore or aft takes care of it, as well as doing the dirty work of converting from farads to picofarads, or from henrys to millihenrys.

The physical facts which these equations represent are those which we've already met in our introduction to reactance. A reactance in a circuit which contains no other elements will always have applied to it the maximum voltage which the source can provide. The reactive element's opposition to change – that is, to change in voltage in the case of a capacitor or to change in current in the case of an inductor – will act to limit the flow of current in the circuit to just that which is necessary to keep the circuit electrically balanced at all times.

We already know that a capacitor, for instance, offers less reactance to a high-frequency signal than to one of low frequency. The more rapid change of applied voltage brought about by the higher frequency signal requires a larger current flow to keep the circuit in balance or equilibrium. Similarly, for two capacitors of different capacitance but with the same frequency of applied ac, the larger capacitor will require more current to keep the charge at just the level which will satisfy the applied voltage.

The reactance equations simply express this relationship between voltage and current, in terms of capacitance (or inductance) and frequency.

Now that we are able to express a capacitor's or an inductor's value as "ohms of reactance" at any specific frequency, let's see how ohms of reactance combine with ohms of resistance. Cast an eye upon Fig. 3, which shows us a resistance-capacitance series circuit.

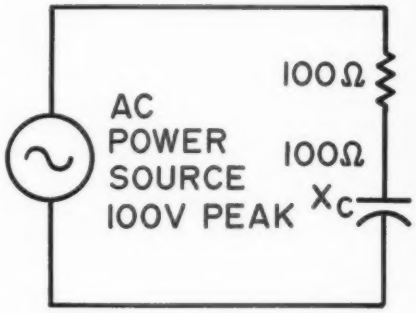

Fig. 3. Series L-C-R circuit illustrates how reactance and resistance combine. Effects of each influence action of total circuit, and result is neither purely resistive nor purely reactive. inductance behaves similarly.

In the explanation which follows, we'll assume that both the resistor and the capacitor are "perfect" or "ideal" components. That is, we'll act as if the resistor has no reactance at all, and the capacitor no resistance.

Since the circuit is a series circuit, by the definition we learned last time around, all of the circuit current must flow through each element. With dc applied, there will be no current after the initial transients die out, because the capacitor interrupts its path. But with ac, current will flow at all times, as the capacitor charge follows the applied voltage during each cycle.

Were the capacitor alone in the circuit, the voltage would be varying up to the full peak value provided by the power source, and the current would be that value defined by the capacitive reactance formula; with a 100-ohm reactance, it would be 1/100 the voltage value. In addition, the current waveform and the voltage wave-

PAGE SEVENTY-THREE

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form would be 90 degrees out of phase with each other.

Were the resistor alone in the circuit, the voltage would also be varying up to the full peak value provided by the power source, and the current would be that value defined by Ohm's Law; with a 100-ohm resistance, it would be 1/100 of the voltage value just as for the reactance we just looked at. In the resistor, however, current and voltage waveforms would be *in* phase with each other.

What happens when both are in the circuit? We know that any current which flows through one must flow through the other. Let's assume that our power source is putting out 100 volts peak (200 volts peak to peak, or 70.7 volts rms) and that both the resistance and the reactance have values of 100 ohms each (at 0 and –90 degree angles, respectively). That would indicate that 1 ampere peak would pass through either element alone. Let's see what happens when we assume that 1 ampere is passing through *both* in series.

We would, by Ohm's Law, find 100 volts peak, in phase with the current, across the resistor – and by similar reasoning, we would find 100 volts peak across the capacitor also, but this would be 90 degrees out of phase with the current and so would also be 90 degrees out of phase with the voltage across the resistor as well.

What happens when we have two voltages out of phase with each other in the same circuit? Figure 4 shows some waveforms which may help us to see the result. When one of the voltages is at its peak, the other is just crossing zero. When the second reaches peak, the first is crossing zero. For a part of the cycle, both have the same polarity, and for a part of the cycle, they have opposite polarity.

But we cannot have *two* voltages in one circuit, not across the outside terminals of the circuit. At any one measuring point, we can have only *one* observable voltage and *one* observable current. Since we can imagine each of our voltages separately, let's stretch our imaginations a bit more and see what happens when we merge them together into a single waveform.

At point A, voltage I is zero and voltage

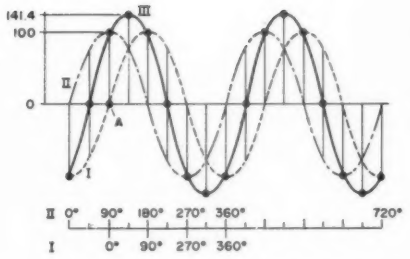

Fig. 4. Waveforms of voltages in circuit of Fig. 3 show what happens in combined circuit. Voltage I represents voltage across resistor, Voltage II is that across capacitor, and Voltage III is that across the total circuit. Voltage III is determined by adding together the values of I and II at each point along the time scale. Note that final voltage is halfway between original voltages in phase, and is greater than either alone but not twice as great as either.

II is at positive peak. The "merged" result (III) must be simply whatever value voltage II has right then. A little later, the two original voltages cross each other, one on the way up and the other coming down. Voltage III at this point must be equal to the sum of both, or twice as great as either.

In fact, all the way through the cycle voltage III must be equal to the sum of voltage I and voltage II. Where the two are of opposite polarity and tend to cancel out, read "difference" (most texts use the phrase "algebraic sum" to indicate that cancellation or reinforcement either can occur, depending on relative polarity).

And voila! Voltage III is still a sine wave, just like the two waveforms of which it is composed –but it's not in phase with either of them. It does, in fact, split the phase difference, so that it is 45 degrees out of phase with the current.

We still have one small insect in the unguent. Our original 100-ohm values were based on a 100-volt-peak source and 1 amp current. Voltage III has a peak value considerably greater than 100 volts. It works out to be 141.4 volts, if you care to measure it (and if our illustrator has drawn his sine-wave curves accurately).

However, in a series circuit, the total voltage across the outside terminals where we're observing voltage III must be equal

to that provided by the power source. That means that we can't have 141.4 volts here; we are limited to 100 volts for the total.

We compensate for this by assuming a reduction in current, and this is only reasonable since whatever the resistor turns into heat isn't going to be available to the capacitor. To cut the total voltage from 141.4 to 100 we can merely divide it by 1.414. This indicates that we should divide our current figures by 1.414 also, so that we have only 0.707 ampere peak instead of 1 amp.

With 0.707 ampere through the resistor, the voltage across it becomes 70.7 volts peak. That same 0.707 ampere through the capacitor sustains a 70.7-volt peak potential across it, and if both voltage I and voltage II are 70.7 volts peak, then their combination into voltage III will produce 100 volts peak, and everything balances properly.

We have seen, through some illustrations and a lot of specific numbers, that 100 ohms of capacitive reactance combine with 100 ohms of resistance to produce a result different from either reactance or resistance. What is this result called?

Its name is "impedance," and like resistance and reactance, it is measured in ohms. The name "impedance" comes about because impedance is the combination of resistance and reactance, both of which impede the transfer of electrical energy.

How many ohms of impedance does our sample circuit have? We could take a stab at figuring it out by applying Ohm's Law to the figures we finally worked out of 100 volts and 0.707 amperes; this would give us a figure of 141.4 ohms for "R" – but it's impedance rather than resistance we're figuring, and "R" is the abbreviation for resistance. Impedance is always abbreviated as "Z," while reactance is "X" with a C or L subscript to identify it as capacitive or inductive.

That stab is exactly accurate, because Ohm's Law does work for ac circuits just as well as for dc if all the "R" factors are replaced by Zs. However, there are simpler ways of expressing impedance than by having to figure out all the currents and voltage drops in a circuit.

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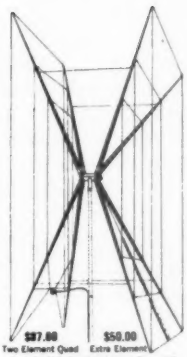

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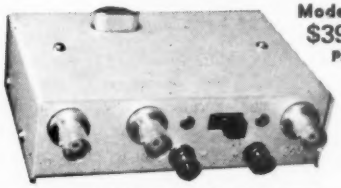

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One of the simplest ways to express impedance, and one which is in wide use by engineers and sufficiently general use in the ham field to make it necessary that you know it, is not to combine the R and X at all into a single figure, but to express impedance as a sum "R ± jX." The sign is plus if X is inductive, and minus if X is capacitive (that is, the sign in the sum follows the sign of the reactance). This is known as the "complex" expression of impedance, because it's the form used in mathematics to express "complex numbers," but it's actually less complex than the arithmetic you have to go through to combine the R and the X into a single value of Z.

The impedance of our sample circuit, expressed this way, would be "100 – j100" ohms. The "j" is an indicator telling us that the number it accompanies is a reactance rather than a resistance.

For many purposes, this is the clearest way to put it. One of the major ham applications of "complex" impedance values is in rating feedpoint impedance of antennas and transmission lines. The object in this case is to get the "j" value to zero, which we can do by adding reactance of the opposite sign, and the "R ±jX" way of expressing the value tells us directly how much and what kind of tuning reactance is necessary.

The other way of expressing impedance reduces the sum to a single number, such as the 141.4 ohms we came up with a few paragraphs back. To be accurate about it, such a number must always be accompanied by its phase angle, so that the

Fig. 5. This "number line" is basis of graphical method of determining impedance values. It provides conversion from picture to actual values.

impedance of our sample circuit is actually 141.4∠-45° ohms. To show why the angle is necessary, and to show how to figure the number and angle, we're going to have to put it in some more pictures.

If you've been exposed to "the new math" either as a student or as a sidelines observer, you have probably met a "number line" already. If not, one awaits in Fig. 5. This is just a line divided into regular spaces, like a ruler, with zero in its middle. Each space to the right of the zero point is one more positive number, and each to the left is a negative number, so that the spaces run -4, -3, -2, -1, 0, 1, 2, 3, 4 . . . The idea is that this "number line" offers a picture of the way we count things, and we can use a number line to illustrate anything that is countable, which includes the number of ohms of impedance, resistance, or reactance in a circuit.

This "number line" idea is, in fact, the basis of all the graphs we use to show how quantities vary with respect to each other, because the two axes of any normal graph are simply crossed number lines.

We can cross two number lines as shown in Fig. 6, crossing them at their zero points and placing them at right angles to each other, to show how resistance and reac-

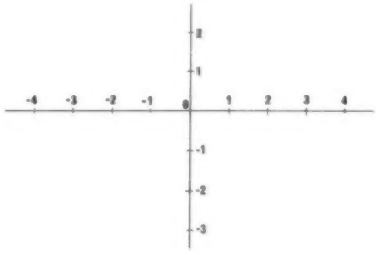

Fig. 6. Crossing two number lines at right angles gives us a "number plane" on which we may draw a graph. The two number lines provide scales for the graph.

tance combine. It doesn't really show "how," but as we shall see everything fits properly, so the idea is workable (the real "how" is the combining of voltages which we've already suffered through back in Figs. 3 and 4.) We shall call the horizontal scale the resistance or "R" scale and the vertical scale the reactance or "X" scale. "Negative resistance" is hard to find, so most of the time we'll use only the right-hand half of the resistance scale, but both halves of the reactance scale come

into play because of our convention that capacitive reactance is negative while inductive reactance is positive.

If we plot our 100 ohms of resistance from Fig. 3 and the -100 ohms of capacitive reactance on the graph of Fig. 6, we come out as shown in Fig. 7 with a pair of

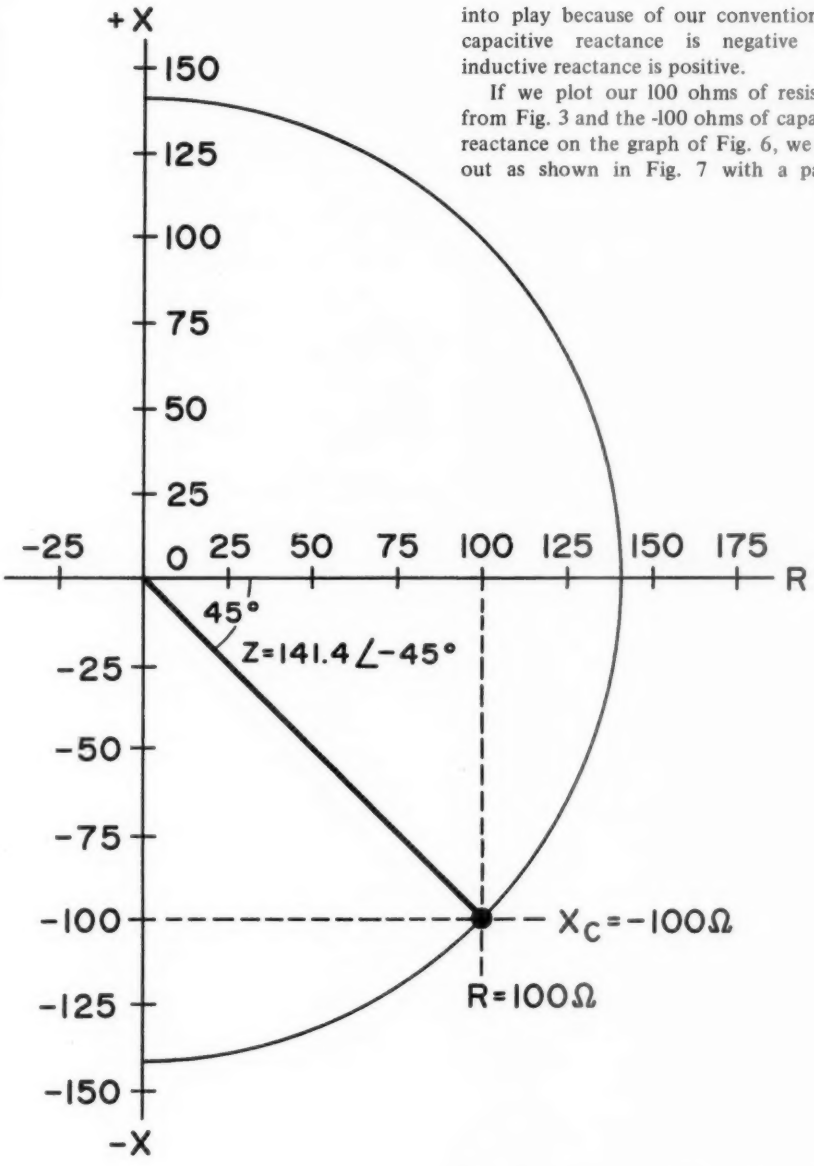

Fig. 7. Combination of 100 ohms resistance (horizontal scale) and 100 ohms capacitive reactance (vertical scale) gives us impedance of 141.4 ohms at phase angle of -45°. Text explains in detail how number plane is used to determine these values. Only right half of plane is needed because the left half represents "negative resistance" values, which are seldom encountered in practice.

dashed lines. The point at which these lines meet represents the combination of 100 ohms resistance and -100 ohms reactance.

We can now draw a straight line from this point back to the common zero point of both lines, and this single straight line represents the combined impedance of the circuit.

If we measure it, we will find (assuming that out illustrator remains accurate in his work) that it comes out to the same 141.4 ohms that we found by arithmetic before, and that it is at a -45 degree angle from the resistance scale.

These are the same figures we worked out previously, and so prove that in this case at least the graphical solution is right. It will be in all cases, because the graph is an exact chart for this particular problem.

Rather than drawing the graph and measuring the impedance line and angle, the normal practice is to calculate them from the relationships of the right triangle. The impedance line is the hypotenuse of the triangle, while the resistance and the reactance are its legs, so that Z^2 must equal $R^2 + X^2$. The trig functions of angles save us the need of working out all of this, because the phase angle can be determined by using the ratio X/R and finding the angle which has this ratio for its tangent. This angle is the phase angle of the impedance; the cosine of this angle is equal to the ratio R/Z, while the sine is equal to the ratio X/Z, so that with a table of trig functions we can get both Z and phase angle if we know R and X, or can get R and X if we know Z and phase angle. Figure 8 shows all the appropriate equations for converting from one way of expressing impedance to the other.

Before we leave Fig. 7, though, we should pause to see why it's so important to always include the phase angle when we're talking about impedance if we don't use the "complex " method.

We found, using Fig. 7, that the impedance of our sample circuit was 141.4 ohms of pure resistance, 141.4 ohms or pure reactance of either sign, or *any* combination of R and X which would bring us to a point lying on the circle in Fig. 7, because every point on this circle is 141.4 ohms away from the zero point.

To make sure that the *one* point representing the combination "100–j100" ohms is understood, we must add the $\angle -45°$ phase angle information. This angle defines a line which starts at the zero point and goes on indefinitely at a 45-degree angle. However, the line and the 141.4-ohm circle can cross each other only once, at a single point, and so the two together make our impedance specification exact.

Now that we're on reasonably solid ground with resistance, reactance, and impedance, we can turn our attention to the question of how like reactances combine in series circuits. So long as it's the same kind of reactance, and assuming (it's important to note that this assumption can hardly ever be achieved in practice) that each reactance is completely independent of every other one in the circuit, they will simply add together like resistors would. What they will add, however, is their *reactance* rather than their capacitance or their inductance. Two capacitors, each having 100 ohms reactance by itself, would produce 200 ohms reactance when connected in series. A quick look at the reactance equations will show that this is the same as one capacitor of *half* the capacitance.

Most textbooks have a string of equations for you to memorize in this respect, in order to calculate the total effective capacitance of any number of capacitors connected in series. We're showing you the equations as Fig. 9, but you don't really need them. All you need do is figure out the effective reactance of each capacitor at

$|Z| = \sqrt{R^2 + X^2}$ $\qquad$ $R = |Z| \cos \theta$

$\theta = \text{ARCTAN} \left(\frac{X}{R}\right)$ $\qquad$ $X = j|Z| \sin \theta$

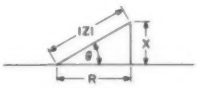

Fig. 8. These are the four equations which are used to convert from "polar plot" impedance expression (Z ohms at phase angle θ) to "rectangular plot" or "complex" expression (R + jX). Vertical bars on either side of "Z" in equations mean "absolute value without regard to sign." Sketch identifies variables with respect to Fig. 7. "Arctan" means "the angle whose tangent is."

some arbitrary frequency such as 159 kHz (which will cancel out all conversion factors if you use it), then total up all the reactances and convert the resulting total reactance back to a single value of capacitance by reversing the conversion formula.

The same trick works with inductors – but if you use a frequency of 1/159 MHz for them, you'll find that it boils down to simply adding up inductances the same as for resistors.

The same trick works for parallel circuits, if we use a couple of other characteristics which are related to reactance and resistance but are not the same thing. These are "susceptance," which is the reciprocal of reactance, and "conductance," which is the reciprocal of resistance. Susceptance is abbreviated B, and

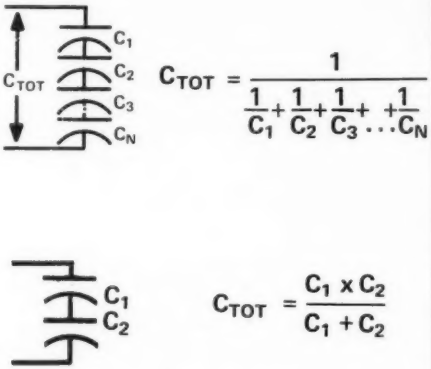

Fig. 9. General equation for determining effective value of several capacitors connected in series is shown at top. If just two capacitors are involved, simplified equation at bottom may be used. Since both these amount to an addition of susceptances (see text) and conversion back to reactance, they also apply to parallel resistors and to parallel inductances, by substituting "R" or "L" for "C" in the appropriate formula.

conductance as G. Impedance, too, has a reciprocal – "admittance," abbreviated Y. In parallel circuits, just total up admittances; in series circuits, total impedances.

Since like reactances in series behave just like resistors in series so far as total effective value is concerned, and since Ohm's Law holds for ac as well as dc when

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we substitute "Z" for "R" in the equations, it's only natural to expect that ac voltage across a series string of like reactances would divide just as dc voltages do across a string of resistors.

The expectation is correct. In similar fashion, the current through parallel reactances of like sign will divide just as dc divides among parallel resistors.

All of this follows quite naturally from a conclusion which you may have already reached but which we have waited until now to point out: Both "resistance" and "reactance" can be thought of as being merely special types of "impedance," because any pure resistance can be expressed as an impedance of 0 degrees phase angle or "R± jØ," while any pure reactance can also be expressed as an impedance with ±90 degrees phase angle (or "0±jX").

This way of looking at "resistance" and "reactance" as being merely forms of "impedance" lets us consider the ohm as always being a measure of "impedance," in all cases. The engineer's definition of both impedance and ohms is based on this; an "ohm" is the ratio of voltage to current in the circuit, and any quantity measured in "ohms" is an "impedance."

From these definitions, we get such factors as the plate resistance of a vacuum tube, the input and output impedances of amplifier circuits, and many more. We'll go into them in more detail later, when we need to. Right now, we're still working with the basics and building our foundations.

What about such things as "rf resistance" and "skin effect?" Both of these are effects due to impedance, and particularly to inductive reactance.

In the next installment, these areas will be covered in depth. Since they are associated inseparably with the theory covered here, the next chapter will be a continuation of "Part II" in the series, and the figure numbers will continue in the sequence already established.

To prepare yourself for the balance of the discussion, do a little extra studying of the Part I text involving flux lines and current flow. . . .Staff ■

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NEVER SAY DIE *(cont. from page 9)*

constructive criticism will be found in QST, which puts the ball in our court.

Lobbying in Washington

If we don't have the support of our own country, how can we expect to get the support of others? We need the unqualified support of the U.S. delegation when the next ITU conference comes up. The U.S. delegation is by far the most important one at the ITU for two basic reasons. . .first of all because the U.S. has so many subtle means for coercing other countries into going along with its policies. . .and secondly because the U.S. team dwarfs all the others and thus has representation in force on every possible committee. Smaller countries have to choose which committees they will serve on, and just shrug about those they can't manage. The U.S. is on all of them and thus has a finger in every pie. This gives the U.S. quite an advantage over all of the other countries.

Do we have our government behind amateur radio 100%? No, we don't. Our government, like all others, bends in the direction of the pressures being brought to bear. The one radio service that is conspicuous by its total absence in the past has been amateur radio. Virtually our only friend at court has been Senator Goldwater, and he has done fabulously for us. But it is really unreasonable to expect Barry to neglect his responsibilities to Arizona and keep up the pressure for amateur radio that is needed to counter the constant pressures from all of the other radio services.

I wonder if you have any idea of what is involved in lobbying for amateur radio? This means getting in to see senators and representatives to discuss with them the importance of amateur radio to their state and to them. It means getting amateur radio achievements into the congressional record at every opportunity. Now, as you probably know, you don't just walk up to the senate office building and sit down to talk with a senator. He has a schedule that is filled sometimes for weeks ahead and you have to work your way into his schedule at his convenience, not yours. It also means a lot of waiting, because just before your scheduled meeting the senator will be called to the floor for an important debate or vote and you have to wait until he gets back or else get on the list for another appointment next week or even next month.

You have to do a lot of your work by mail, too. The senators will have questions that you will have to research for them. Most of them get letters from ham constituents every now and then and they want some way to get the right answers for these questions as quickly and simply as possible. You can help, but it means time and work. . .and letters. . .and phone calls.

All this is groundwork. Then suddenly along comes some legislation having to do with amateur radio. At this time you need every contact and friend you have made to get the bill into perspective and to round up the votes you need to get it through, stop it, or amend it. You have to know who to contact at the FCC to get the right answers. . .at State. . .etc.

Or perhaps an FCC docket comes up that is important. You can bet that pressure from congress will have a measurable effect on the outcome.

How many of you can tell me who this important man is that we have in Washington lobbying for amateur radio? Is there an ARRL representative working for us there? You know the answer is no, there is no representative of the ARRL lobbying for us in Washington. There is one man in the U.S. that is registered to lobby for amateur radio and only one. . . *me!*

I make the two-hour drive to Boston, the hour flight to Washington, and get in to see everyone I can during the short times that I can get away from 73 and Radio Today, but I want you to know that you are leaning on a mighty weak crutch when you depend entirely on me to beat the drum for amateur radio. I would much rather spend my time up here in cool New Hampshire than down in sweltering Washington . . .and my wife feels the same way about it since she has to mind the store while I'm away. Please ask your ARRL director why our hobby can't do any better than me for a representative of amateur radio.

More JY1

Several amateurs, after reading my report on Jordan, called me long distance to thank me personally for what they considered the most important achievement of my trip. . .a vote for amateur radio at the ITU. Hundreds have called me on the air to thank me for giving them a new country. Letters of compliment continue to come in from all over the country (nothing heard from ARRL yet), plus one sour note from Dave Mann K2AGZ.

Dave writes that "All my Zionist friends have been giving me the business," because the JY article was "pro-Jordan" at a time "when shots fired in Jordan are killing kids in Israeli school buses."

Zionists, above all else, should not be so completely out of touch with what is really going on over there. I do not believe that the Jordanian army is in any way involved with the fedayeen commando attacks. With some 25,000 fedayeen overrunning their country, the Jordanians are virtually helpless to seriously curb these Palestinian refugees. The money and supplies for this guerilla army are provided primarily by Libya and Saudi Arabia, with none coming from Jordan, as I understand the situation. The fedayeen commandos are paid almost four times the money that the Jordanian army gets, by the way. And they are better supplied.

Where does all the money come from for the commandos? The path, as it looks to me, is first from your pocket to your local gas station or fuel oil dealer. From there it goes to the big oil companies. They send it to the Arab oil coun-

tries, who in turn send it to the commandos. I might point out right here that Jordan has no oil whatever.

Perhaps the serious Zionist would do best to consider an electric car, or at least one of the foreign cars that use about one third the gasoline that his Cadillac does.

Those of you who have been following the political situation in the Mideast know that the moderates in Israel and the Arab moderates are almost in complete agreement on solutions to the problems of Palestine. Unfortunately, the extremists on both sides are preventing the moderates from getting together and accomplishing anything. I don't think that anyone would characterize King Hussein as other than a moderate.

Indeed, early in June the gulf between the Jordan government and the commandos resulted in bloody battles, with hundreds killed in Amman and King Hussein almost assassinated. The announcement of more arms for Israel from the U.S. triggered off this fight, a reaction to the commando feeling that Hussein was too friendly to the U.S.

With Israel getting more U.S. arms, and with none being sold to Jordan, the U.S. may finally force King Hussein to make a deal with Russia, though he has obviously been extremely reluctant to do this thus far.

Bum Rap

Reports are rampant that K2IXP (Larry) will be active from the Laccadives (VU4), but on the other hand many seasoned DX ops remember that VU2NR (Raju), the president of the Radio Society of India has been trying for several years to get permission to go there and without success. I may be doing Larry an injustice, but I was a bit annoyed to get the report that he had been invited to Jordan by King Hussein, only to be attacked as he tried to enter the country. I was there and talked with Larry when he was in Amman and I know what happened. The incident was unfortunate, undoubtedly, but it was nothing like that.

When I contacted Larry before my trip to Jordan he was operating as K2IXP/4X4 and mentioned that he and his wife might come over to Jordan while I was there. When he arrived in Jordan he got into trouble almost immediately. I was in the middle of my conferences with the government heads while setting up the Royal Jordanian Amateur Radio Society and couldn't get away to see him. By the next day he had left the country.

Larry explained on the phone that he and his wife had been in downtown Amman looking around when one of the commandos attacked him. Other commandos came immediately to his rescue and rushed him to the hospital for repairs. After a good deal of checking on this I found some confusion about whether the argument started over his wife getting pinched (she was wearing a short miniskirt, which is bad taste in Amman) or his taking pictures of some commandos. At any rate the commandos were most apologetic about the matter and offered to escort them anywhere they would like to go in Jordan.

When I mentioned the incident to His Majesty that evening he said that he had heard nothing of Larry's coming and offered his sincere regret for the trouble and asked his secretary to check the next morning and see what could be done to help. Pat checked and found that Larry and his wife had already left for Syria.

The Opinions Expressed, etc.

Unlike any other ham magazine that I can think of at the moment, the opinions expressed in articles, letters, and editorials, other than by the publisher, in 73 do not necessarily (or even usually) coincide with those of the publisher. Only 73, of all the magazines, recognizes the importance of an outlet for more than one person to make a fool of himself.

How About a Sked?

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. . . Wayne ■

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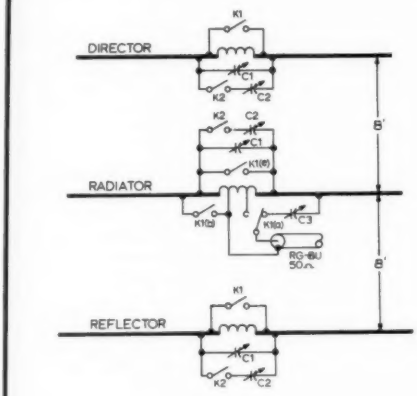
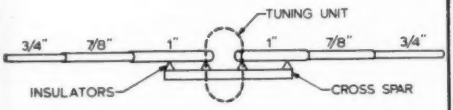
WE BLEW IT!

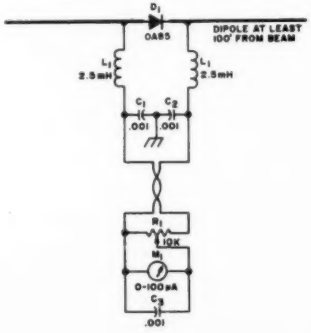
73 left out some important sketches from E.R. Shepherd's June 1970 article entitled "The 663 Beam." The top sketch shows element networks and spacing. The second sketch shows details of element construction. The bottom shows the setup of the remote dipole.

Sorry about that.

. . .Ed.







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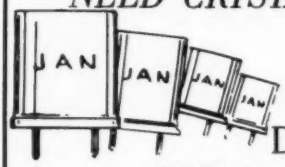

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LETTERS

advised by my lawyers that ou goons don't t ever proofr lousy [illegible] bunch of rocks [illegible] you ignored my comments in I insist that you print ev should be boiled in oil ov

Article Nonpayment

73 has received a number of letters from reader-authors who complain that they are not always paid for their efforts. Many of those who write ask that their names and letters be held in confidence (understandably). Others are quite willing to be quoted. Here are a couple of letters in the latter category. These are representative letters of complaint. For obvious reasons, 73 has not been able to verify the claims.

. . .Ed.

I wrote an article for CQ two years ago and they still haven't paid me. You can find my article in CQ, Nov. '68. The amount is over $150. The attorney general informs me that he can do nothing about it, so feel free to use my name and article and date as you see fit.

Neil Iverson W7PVF
2640 S. 133
Seattle WA

You might contact postal authorities and see if advertising author remuneration without following through might constitute mail fraud.

Could 73 suggest an attorney who has had experience handling cases against CQ? I am interested in bringing "breach of contract" proceedings against Cowan over a booklet manuscript of mine he contracted to publish but won't get on with and refuses to return my material.

John Schultz W2EEY
Arabella St. 18
8 Munich 81, Germany

Wayne is answering your letter personally.

JY1

Hooray for JY1. Now stop playing favorites and get thee over to 4X4-land pronto. Lox and bagels to you.

Anonymous
Clifton NJ

Wayne had complete control of a difficult (DX) situation. It was a real pleasure to hear him. . .in his quiet and forceful way. . .chastise inconsiderate breakers from other areas who kept calling when he specifically called for *sixes*. . .

Steve Cerwin K6OJO
4 Longfellow Rd
Mill Valley CA

The cover pix and article about Hussein (June 1970) is number one! (That wasted space given for article introductory pages is number ten thou.)

Stan Pugh WA7KSC
2521 N. Proctor
Tacoma WA

I'm quite sure that Wayne did a masterful job in getting the Jordanians on the air by getting them started with two classes of license – also

(cont. on page 88)

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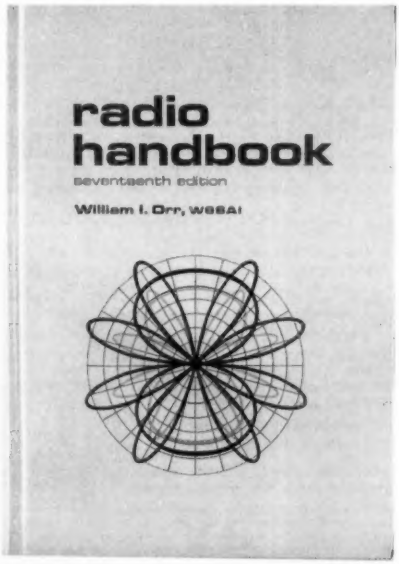

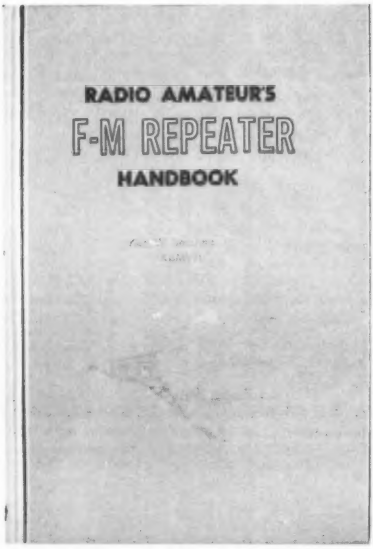

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Club for Blind Amateurs:
K1TPX Perkins Radio Club

The hobby of amateur radio has appealed to some students of Perkins School for the Blind in Watertown, Mass., so much so that they have formed a radio club. There are eighteen members in the club with president George Henault presiding. He is shown here operating the club station, consisting of a Central Electronics 200V with the matching 600L linear. This equipment lends itself well to operation by the students for there is no loading involved. The receiver is a Hallicrafters SX-101A. The antenna is a Mosley TA-33 beam on a 75 ft Tristao crank-up tilt-over tower. Mr. Paul Bauguss, WA1CAQ, the faculty adviser, is responsible for much of this fine gear.

Ted Filteau, a previous president, is learning to build a transmitter with the help of Jim Dossett, KITIH. Jim makes available his Thursday evenings in order to help the members at Perkins. The simple CW transmitter that Ted is building as a project will be operational when finished.

Dick Gonyea, an electrical engineering student at Northeastern University volunteers three hours a week to help the younger members achieve their novice licenses. Glenn Grimes and Paul Burkhardt are studying Braille schematic diagrams under Dick's watchful eye.

The Perkins' Radio Club KITPX has been in existence for about seven years and shows no sign of diminishing.

Henry Champagne

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(cont. from page 84)

for (opening the door for) any ham visitors that may be planning on visiting Jordan in the future. I commend 73 for having a very good cover picture of King Hussein.

Ken Mahoney K6OPG
455 41st Ave.
San Francisco CA

Enjoyed reading about King Hussein. I regret the problems he's had lately. Hope he comes out on top of it all.

Stewart MacKenzie
16182 Ballad Lane
Huntington Bch CA

Thanks to Wayne for what he did for Hussein and for all of us. In impact, it dwarfs another $50 million in lend-lease or whatever the dole is called these days. How about sending the King a decent tribander and rotator so he can hear us a bit better? Could be done on a contribution basis so that it is a personal, men-to-man gift from American hams. (It would) keep out commercial interests and show the man that individuals in the U.S. admire him and can see past politics and apparent government favoritism.

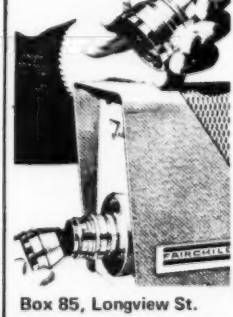
Ned Raub W1RAN
207 Thames St.
New London CT

My appreciation for Wayne's untiring effort in the area of bringing about a better understanding between the U.S. and other countries. With this kind of leadership in our amateur radio ranks, we find a "challenge" and "incentive" to follow up with each opportunity to bring about deeper understanding and brotherhood. It is with renewed interest that I now operate my station. It is good for you to know that you have much support in your efforts to strengthen ham radio at home and abroad. The amateur ranks need what 73 is giving!

Larry Vines WA4WIA
1645 Dobbs Ln
Birmingham AL

Editorials

The editorial by K6MVH in the June issue of 73 in which he says, "Hancock and Adams were the Seales and Hoffman of their time," ripped it with me. This kind of crap is out of place in a technical magazine and I refuse to pay my money for the political philosophy of Mr. Sessions or



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Charles V. Thomas K5EDI
327 Mason
Hot Springs AR

Hancock and Adams were anti-government. They were members of a very vocal minority, and were, only after much persuasive strategy, able to swing public opinion their way. The govenor of Massachusetts ordered their arrest for insurrection, treasonous acts, etc. The chief differences (as far as I can tell) between Hoffman and Hancock are the tactics and motivations. Seale and Hoffman could hardly be considered as heroes.

. . .Ken

This expresses my appreciation for continuing excellent coverage of the significant happenings and affairs in Amateur Radio. 73's objective and "involved" editorializing is in refreshing contrast to the trite, trivial, and paternalistic editorial exhortations of QST.

J.W. Sandbert, K6HE
1138 E. Rustic Road
Escondido CA

Mixed Metaphors

Dear Editors: Been reading 73's comments on ARRL. Now I have no howdy do for either of you. But I think you are looking for someone to fight a war for you. If you have all the answers, why in Hell don't you grab the bull by the horns and take over. You remind me of a young snotnose – along with the ARRL! Grow up. Kid, if you can't face the music, get out of the competition game. Soon as I find the QTH for "past life" extension am going to subscribe for life just to see how long you take growing up.

Mr. L. Venzor WA9PAH
3011 South Ave.
Chicago IL

73's Study Guide

I am pleased to renew my subscription to 73 for another three years. 73 has shown a vast improvement over the last several years and is making a great contribution to amateur radio with the license study course you so wisely published. I find that other magazines are either too technical or have just deteriorated. I am not renewing my subscriptions to these other magazines when they run out. I am now a life member of ARRL and will continue to support it. Keep up the good work.

Alfred Smith WA2TAQ
11 Irving Place
Lynbrook NY

Your theory on how to pass exams should be put in a book form. It's the best thorough explantion I've ever seen. Your SSB article cleared up a lot for me.

J. Brousek
4704 Bragdon
Cleveland OH

The study courses are available from 73 bookshop – $3 postpaid. Specify Advanced or Extra.

One of the fellows in my office showed me the 73 Advanced Class license handbook. I'm much impressed. As an ex-military electronics instructor I'd judge it to be as good a discussion

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of radio principles and practices as I've seen. It certainly doesn't bear much resemblance to that tortured language in the ARRL Handbook or my college textbooks.

David Halliburton W9EQG
10809 Old Coach Road
Potomac MD

I am a newcomer to ham radio and I would like to thank you for your *Advance Class study guide*.. I became interested in radio years ago but did nothing about it. But in November 1969 I purchased two code practice tapes (Codemaster) and your study guide. As a result of my practice and study, I was able to breeze through the Advanced ham license test in February.

Edward H. Stiles WA6RDB
6529 Hillgrove Dr.
San Diego CA

Thank you very much for providing the Advanced & Extra Class study guide. I failed the Advanced the first time, but after reading your study guides I passed them both! I operated CW 99% and could not bear to lose the best parts of the bands. Otherwise I doubt if I would ever have sought the Extra Class. Thanks again.

Ken WA9OQE

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Herman Lubinsky
United Radio Co.
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All right, who's the wise guy who is making it rough on our advertisers?

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I am very much interested in your Ham Hospitality Scheme, and hereby offer my home for any visiting ham, especially a married couple or a lady. My interest is ham radio and I am in timber business. XYL, 36 yrs. old, is interested in cooking, painting, and embroidery. Visitors and their children will be welcomed, and we can arrange for their accommodation if they are willing to share the bedroom with us. We will allow them to use one kitchen as our food (Indian) will be different.

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If they wish, they can bring one latest issue of their country's call book or a magazine. Hams from any part of the world are welcomed and will be made comfortable.

Jimmy J. Mistry
Bella Vista
Bandra Bombay 50,
India

With reference to several publications observed in the 73 magazine about accommodation for visiting hams, I wish to let it be known that visiting hams to Trinidad and Tobago are welcome at our QTH with such activities as: Island wide tour, DXing with rig in shack, meeting the local hams, living accommodations with meals only if necessary, help on current project in shack accepted but optional.

Victor L. Steele
96 Charlotte Street,
Port-Of-Spain,
Trinidad, W Indies

Powder Puffs

I read with interest the article by Dave Middelton W7ZC "Ground Support for the Powder Puff Derby," June '70. This issue is being called to the attention of all our membership so they can enjoy this feature.

Penn-Jersey YL Club will be handling the terminus portion of the 1970 Derby at the 3M airport. The national chairman is one of our members and has appointed me as radio chairman for the terminus. This article gives us a complete scope of what we may expect during our coverage in this public service as a club. I am most anxious to meet some of the race officials, especially because our daughter is learning to fly and is also a licensed amateur. We hope to see future articles such as the one by W7ZC.

Rose Ellen Bills WA2FGS
17 Craig Place
Pennsville NJ

Hobby License

Your proposal for a no-code/no-theory "Hobby" license hit me like an invigorating blast of fresh New England air on a frosty Autumn morn. You are to be commended for this imaginative, yet practical, remedy to a hypocritical situation which has reached the bounds of absurdity. This proposal merits the wholehearted support of hams and CB'ers, League and non-Leaguers, alike. Even though the hour is late, it still just might be possible under this proposal to weld the ham fraternity back together again.

73 Magazine is certainly demonstrating its positive leadership in the field of amateur radio. The strong editorial positions are doing much to close the "communications gap" that our hobby has been plagued with lately. It's comforting to know that someone is more concerned with hams than simply "hamstringing" them . . .

Ed Collins WN6ABG
161 Arlington Ave.
Kensington CA

QSL for Profit?

I must disagree and take umbrage with Mr. Shawsmith and his statements in his article "QSLing, Ham Radio's Own Con Game!" I have been a QSL manager for several years and sincerely believe that he has a nerve making such statements and you have the same for publishing them.

I do not intend to make a detailed legal reply to the unfounded allegations set forth therein. However, I can say that if it were not for the QSL manager, a great deal of the DXing as it is today just would not be. The only fault that can be found with the system is that there is such a demand among awards for QSLs themselves

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which makes it essential that they be possessed.

There is hardly any need telling you that if a DX station were obliged to handle the entire load of his QSLs he would have no time to operate. Then there is the little matter of expense to the station which desires the QSL. But to say that a QSL manager gains glory, financial remuneration, ego lift, is open to bribery, etc., is tantamount to libel against the majority of those hams who take their own time, generally spend their own money, and exert their effort to reply for the DX station.

It appears that the foreign amateurs do not understand that the U.S. does not have a free QSL bureau as most of the other countries have. Consequently, when the QSL manager receives hundreds of cards through the ARRL bureau for the DX station he QSLs, it costs him money to reply! This includes the SWL cards, which come in droves.

I fully believe that your author has some ax to grind with some QSL manager. But what I do not understand is why you see fit to print such stuff.

Gay E. Milius, Jr. W4NJF
1416 Rutland Drive
Virginia Beach VA

VK4SS's article really hit home. I have been an extensive QSLer during my 5 years as an amateur. I kept close track of the last 800 cards sent out, which netted 455 returns. I have noticed several trends in QSLing: Returns ranged from a low of 35% on 20m SSB to a high of 80% on 6m (SSB + CW). 40m was about 50%; 15m, 60%; 10m, 65%. CW on all the HF bands was slightly better. DX stations were surprisingly good at almost 70%, and that was by the bureaus. Of about 15 SASEs sent to managers, only one never came back. I never sent any IRCs and very few DX cards direct.

In my opinion the worse ones are the ones who promised QSLs but never sent them. For a while on 20m I asked everybody if they QSLed but it only raised returns a few percent. To those few who said they didn't QSL I still think you're cheap and lousy and no good but thanks for being honest and saying you don't QSL.

Stephen J. Powlishen WA1FFO
53 Oak St.
East Hartford CT

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Occasionally even the best builder will make a boo-boo which sticks out like a sore thumb. Here is a way to avoid one of the most common goofs and one of the more obvious to the casual observer.

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. . . . Bill Turner WA0ABI

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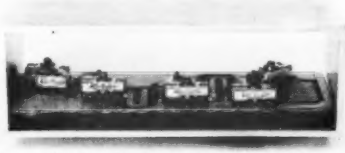

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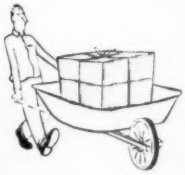

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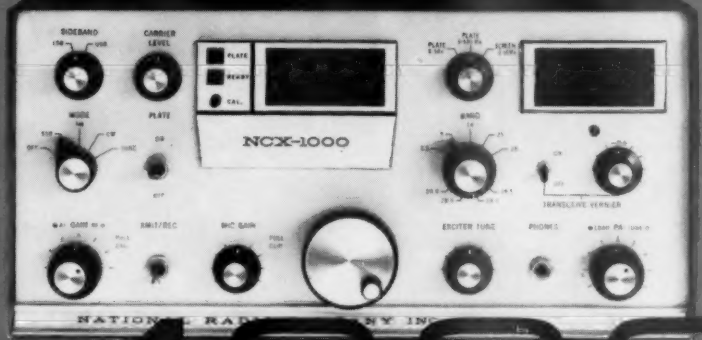
ALASKA	14	14	14	7A	7	7	7	7A	14	14	14	14
ARGENTINA	21	14A	14	14	7	7	14	14	14	21	21	21
AUSTRALIA	14	14	14	14	7B	7	7	7	7	7	14	14A
CANAL ZONE	21	14	14	14	7	7	14	14	14	14	21	21
ENGLAND	14	7A	7	7	7	7	14	14	14	14	14	14
HAWAII	14	14	14	14	7	7	7	7	14	14	14	14A
INDIA	14	14	14	7B	7B	7B	7B	7A	14	14	14	14
JAPAN	14	14	14	7B	7B	7B	7B	7B	14	14	14	14
MEXICO	14	14	7	7	7	7	7	7	14	14	14	14
PHILIPPINES	14	14	14	7B	7B	7B	7B	7B	14	14	14	14
PUERTO RICO	14	14	14	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7B	7B	7B	7	7B	7B	14	14	14	14	14	14
U. S. S. R.	7	7	7	7	7	7	7	7A	14	14	14	14

WESTERN UNITED STATES TO:

ALASKA	14	14	7A	7	7	7	7	7	7A	14	14	14
ARGENTINA	21	21	14	14	7	7	7	14	14	21	21	21
AUSTRALIA	21	21A	21A	14A	14	14	7A	7	7	7	14	21
CANAL ZONE	21	14	14	14	7	7	7	14	14	14	21	21
ENGLAND	14	7	7	7	7	7	7	7A	14	14	14	14
HAWAII	21	21	21	21	14	14	7	7	14	14	14	21
INDIA	14	14	14	14	7B	7B	7B	7B	14	14	14	14
JAPAN	14	14	14	14	14	7A	7	7	14	14	14	14
MEXICO	14	14	14	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	14	14	14	7B	7B	7B	14	14	14	14
PUERTO RICO	14	14	14	7A	7	7	7	14	14	14	14	14
SOUTH AFRICA	7B	7B	7B	7B	7B	7B	7B	14	14	14	14	14
U. S. S. R.	7B	7	7	7	7	7	7	7	14	14	14	14
EAST COAST	14	14	14	7	7	7	7	14	14	14	14	14

A—Next higher frequency may be useful this period
B—Difficult current this period

NCX 1000



1 kw Solid State TRANSCEIVER (80–10 Meters)

Here's a transceiver designed for the amateur who would rather spend his hard-earned radio dollar on performance than frills. The NCX-1000 is built to meet the demands of the operator who needs and desires a high performance SSB-AM-CW-FSK rig with solid-state dependability and plenty of power. Add to this the convenience of having your transmitter (including linear amplifier), receiver, power supply, and monitor speaker in a single, compact, smartly styled 59 pound package.

So let's look at the NCX-1000, starting with the double-conversion, solid state receiver. After the received signal is processed by a double-tuned preselector, a stage of RF amplification, and another preselector, it is applied to the first mixer for conversion to the first IF frequency. The first IF contains passband filters and a stage of amplification. A second mixer then converts the signal to the second IF frequency for additional processing by a 6-pole crystal-lattice filter and four IF stages. Finally, the signal is detected and amplified by four audio stages. The unparalleled high dynamic range lets you tune in weak stations surrounded by strong interfering signals. The result? High performance for SSB, AM, CW, and FSK. Sensitivity of 0.5 EMF microvolt (for a 1Q db S-N/N ratio).

In the transmitter you'll find three stages of speech amplification followed by a balanced modulator, a crystal-lattice filter, a filter amplifier, and an IF speech processor (clipper). A mixer converts the signal to a first IF frequency for processing by two crystal passband filters, and two IF amplifiers. A second mixer converts the signal to the transmitting frequency where it is amplified in five RF stages before it gets to the grid of the 6BM6 driver. Final power amplification takes place in a forced-air-cooled 8122 ceramic tetrode which feeds the antenna through a pi network. Other features? You bet! Grid block keying for CW. Complete metering. Amplified automatic level control (AALC).

So here's a package that can give you 1000 watts PEP input on 80 through 10 meters, 1000 watts on CW, and 500 watts for AM and FSK. The speech processor lets you double your SSB average power output with minimum distortion. No frills with the NCX-1000. Just top performance.

For complete (and impressive) specifications and details, write:

NATIONAL RADIO COMPANY, INC.

NRCI 37 Washington St., Melrose, Mass. 02176

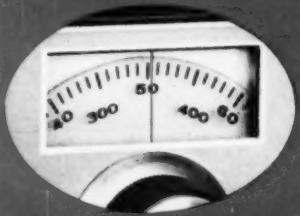
DRAKE

- *Direct Frequency Dialing*
- *Programmable Coverage*

COMMUNICATIONS RECEIVER

- *All Solid State*
- *FET Circuitry*

MODEL SPR-4 ... $449.00 NET



Precision tuning dial . . . tune station frequency directly . . . no searching.

Programmable frequency coverage . . . change crystal and label on dial.

The SPR-4 is a general purpose receiver which may be programmed to suit any interest: SWL, Amateur, Laboratory, Broadcast, Marine Radio, etc. Frequency Coverage: 150-500 KHz plus any (23) 500 KHz ranges between .500 and 30 MHz.

FEATURES: • **Linear dial** with 1 KHz readout • **4-pole crystal** filter in first IF • **4-pole LC filter** in second IF • **Three bandwidths:** 0.4 KHz, 2.4 KHz, and 4.8 KHz for: CW, SSB, AM • **AVC time constants** opimized for each mode • **Superior** cross-modulation and overload performance • **Power:** 120 VAC, 220 VAC, and 12 VDC • **Crystals supplied** for LW, standard broadcast and seven shortwave broadcast bands • **Built-in speaker** • **Notch Filter.**

ACCESSORIES: 100 Khz calibrator, noise blanker, transceive adapter (T-4XB), DC power cord, loop antenna, crystals for other ranges.

For more information write

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